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United States Department of State

Chemical Warfare in Southeast Asia and Afghanistan

Report to the Congress
from Secretary of State
Alexander M. Haig, Jr.,
March 22, 1982

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THE SECRETARY OF STATE
WASHINGTON

TO THE CONGRESS OF THE UNITED STATES:

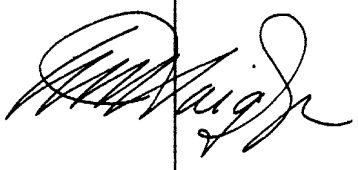
The years from 1914 to 1918 were among the most destructive of human life in mankind's history. Yet the sacrifice of millions brought no lasting peace. Of the elaborate structure for collective security, and the series of pacts outlawing war and controlling armaments which were negotiated in the aftermath of this First World War, little remains today. The League of Nations, the Kellogg-Briand Pact, and the Washington Naval Agreement were all swept away in the tide of aggression which culminated in a second global conflict. Almost the sole surviving monument, in the law of nations, to the twenty million dead of the First World War is the 1925 Geneva Protocol outlawing chemical and biological warfare.

Today this accord, among the oldest of arms control agreements still in force, along with another more recent such agreement banning biological and toxin weapons, is again in danger of being swept away by a new tide of aggression. Over the past seven years chemical and toxin weapons have been used, on an ever-widening scale, in genocidal campaigns against defenseless peoples. These weapons are being used for precisely the reason mankind has condemned and sought to outlaw them—because of their indiscriminate action and horrific effects. Today evidence of chemical and toxin warfare has accumulated to the point where the international community can no longer ignore the challenge.

The enclosed report on the use of chemical and toxin weapons by the Soviet Union and its Allies in Laos, Kampuchea, and Afghanistan has been prepared for submission to the Congress, to the United Nations, and to each member of the international community. The report is drawn from information made available to the United States Government since 1975. It contains the most comprehensive compilation of material on this subject available, and presents conclusions which are fully shared by all relevant agencies of the United States Government.

The international community and the world public need not rely solely on this report to form their judgment, nor only upon the United States to provide their information. Lethal chemical and toxin weapons are regrettably still in use in Laos, Kampuchea, and Afghanistan. New victims appear, new witnesses come forward, new scientific evidence is uncovered with increasing frequency. The great bulk of the information in the enclosed report could have been collected and analyzed by any interested government, international organization, or major news service. If the efforts of tne United States Government to call attention to chemical warfare in Afghanistan and Southeast Asia stimulate others to discover for themselves, and join in efforts to expose the truth, this report will have served its most important purpose.

Sincerely,



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This study presents the evidence available to the U.S. Government on chemical warfare activities in Laos, Kampuchea, and Afghanistan through January 1982 and examines the Soviet involvement in those activities. It is based on a massive amount of information, from a variety of sources, which has been carefully compiled and analyzed over the years. The paper is accompanied by annexes and tables that provide details of the medical evidence and sample analyses, a technical description of trichothecene toxins, and other supporting data.

INTRODUCTION

Nearly 7 years ago, reports of the use of lethal chemical weapons began to emerge from Laos. In 1978, similar reports started to come from Kampuchea, and in 1979 from Afghanistan. Early reports were infrequent and fragmentary, reflecting the remoteness of the scene of conflict and the isolation of those subjected to such attacks. In the summer of 1979, however, the State Department prepared a detailed compilation of interviews with refugees from Laos on this subject. That fall, a U.S. Army medical team visited Thailand to conduct further interviews. By the winter of 1979, the United States felt that it had sufficiently firm evidence of chemical warfare to raise the matter with the governments of Laos, Vietnam, and the Soviet Union. All three governments denied that a basis for concern over the use of chemical warfare agents existed.

Dissatisfied with these responses, and possessing further reports that lethal chemical agents were in use in Southeast Asia and Afghanistan, the U.S. Government in 1980 began to raise the issue publicly in the United Nations, with the Congress, and in other forums. In August of that year, the State Department provided extensive documentation containing evidence of chemical weapons attacks to the United Nations and also made this material publicly available. In December, as a result of efforts by the United States and other concerned nations, the U.N. General Assembly voted to initiate an international investigation into the use of chemical weapons. This investigation is still underway. To date, the U.N. investigating team has been denied admission to any of the three countries where these weapons are in use.

Despite the volume of information on chemical warfare in Southeast Asia which had become available by 1980, there remained one major unresolved issue—the exact nature of the chemical agents in use. Collection of physical samples was hindered by the remoteness of the then principal areas of conflict—as many as 6 weeks by foot to the nearest international border. Tests for known chemical warfare agents on those samples that were obtained proved consistently negative.

In order to identify the chemical agents in use, U.S. experts in late 1980 began to go back over all the reporting—as far back as 1975—looking for new clues. In particular, they sought to match the reported symptomatology of victims—which commonly included skin irritation, dizziness, nausea, bloody vomiting and diarrhea, and internal hemorrhaging—with possible causes. As a result of this review, the U.S. Government in mid-1981 began to test physical samples from Southeast Asia for the presence of toxins. These substances are essentially biologically produced chemical poisons. Although they have never before been used in war, this was a technical possibility, and it was noted that certain toxins could produce the sorts of symptoms observed in Southeast Asian victims of chemical warfare.

In August 1981, unnatural levels and combinations of lethal trichothecene toxins were detected in the first sample to be tested by the United States for such agents. This consisted of vegetation taken from a village in Kampuchea where an attack occurred in which people had died after exhibiting the symptoms described above. In succeeding months, further samples, taken from the sites of attacks in both Kampuchea and Laos, yielded similar results. So did samples of blood taken from victims of a chemical attack in Kampuchea.

Despite a continued flow of reports, dating back over 7 years, of chemical warfare in Southeast Asia and more recently Afghanistan, and despite the still mounting physical evidence of the use of trichothecene toxins as warfare agents, doubts as to the conclusive nature of the available evidence have persisted. These doubts have arisen for several reasons. For one, the evidence of the use of lethal chemical weapons has become available over a period of several years and from a variety of sources. Few governments, journalists, or interested members of the public have been exposed to all of this evidence, nor has it been available in any one place. A second difficulty has been the inevitable need for the U.S. Government to protect some of the relevant information, often gathered at personal risk to individuals who secured it, or obtained through the use of highly sensitive methods.

Chronology of Diplomatic/ International Actions on Chemical Warfare Use

October 1978

The United States called to the attention of the Lao Charge d'Affaires in Washington the press reports alleging use of poison gas in Laos.

Assistant Secretary of State for East Asian and Pacific Affairs Holbrooke traveled to Vientiane and discussed our concerns over H'Mong human rights and other issues with Lao leaders.

Late 1978

The Department of State directed U.S. diplomatic missions in the Southeast Asia area to seek to develop information on the alleged use of poison gas against the H'Mong.

January 1979

The Department of State again informed the Lao Embassy of U.S. concerns about reports of poison gas use in Laos, coupling this with a similar demarche in Vientiane. The Lao denied the validity of the reports.

March 1979

The U.S. Representative to the 35th session of the U.N. Human Rights Commission expressed U.S. concern about the plight of the H'Mong, specifically raising the poison gas use issue.

May 1979

A State Department representative went to refugee camps in Thailand to interview H'Mong claiming to be eyewitnesses and/or victims of poison gas attacks in Laos.

A State Department representative visited Vientiane where he discussed the problem with various diplomatic missions and the senior U.N. representative in Laos. During that visit, he raised U.S. concerns about the problem directly with the Lao Foreign Ministry.

September 1979

A Department of Defense medical team was dispatched to Thailand to interview and prepare a report on H'Mong refugees having knowledge of gas attacks in Laos.

November 1979

Demarches were made to the Vietnamese in Paris and to the Soviets in Moscow expressing U.S. concerns about reports of poison gas being used against "resistance forces" in Laos. Both the Soviets and Vietnamese supported the Lao denial of the validity of the reports.

December 1979

State and Defense Department officials presented evidence of gas attacks in Laos to the House Foreign Affairs Committee.

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February 1980

A bilateral demarche was made to the Soviets about U.S. concerns regarding chemical warfare use in both Laos and Kampuchea and about reports that chemical weapons were being used by the Soviets in Afghanistan. The demarche was made in Geneva in the context of the U.S./Soviet bilateral negotiations on a comprehensive prohibition of chemical weapons production, development, and stockpiling.

May 1980

An interagency team of U.S. Government political, technical, and intelligence officers was dispatched to Europe to brief the allies about the problem and to stimulate support for having an impartial international investigation conducted.

July 1980

Another bilateral demarche was made to the Soviets in the context of the U.S./Soviet bilateral chemical warfare negotiations, concerning the problem of the reported use of chemical weapons in both Southeast Asia and Afghanistan.

The Inter-Parliamentary Union adopted a resolution calling for an impartial international investigation of reports of chemical weapons use.

August 1980

The United States circulated to U.N. member states a 125-page compendium of reports and declassified intelligence information pertaining to the use of chemical weapons in Laos, Kampuchea, and Afghanistan.

The 40-nation Committee on Disarmament included language in its Annual Report to the U.N. General Assembly on the need for an impartial international investigation of the problem of chemical weapons use.

December 1980

With the full and active support of the United States, the West, and others, the U.N. General Assembly adopted a resolution (A/35/144 C) establishing a U.N. investigation, under the auspices of the U.N. Secretary General and with the assistance of qualified medical and technical experts, of reports of chemical weapons use. The vote was 78 in favor to 17 opposed, with 36 abstentions.

March 1981

In accordance with U.N. General Assembly Resolution A/35/144 C and the request of the U.N. Secretary General, the U.S. submitted detailed information pertaining to the reports of the use of chemical weapons in Southeast Asia and Afghanistan. The U.S. submission consisted of a letter summarizing the U.S. submission, the U.S. compendium of reports from August 1980, an update to that compendium covering the period through January-February 1981, the transcripts of congressional hearings held on the subject in December 1979 and in April 1980, and the texts of House and Senate resolutions condemning the use of chemical weapons.

July 1981

The United States provided further details and written responses to questions from the U.N. Group of Experts concerning the U.S. submission of March 1981.

September 1981

Secretary Haig announced, in his September 13 speech in Berlin, that the United States had obtained physical evidence of the use of lethal mycotoxins in Southeast Asia, discovered in the analysis of a leaf and stem sample obtained from the site of a chemical attack in Kampuchea.

On September 14, the United States submitted a report on the new evidence pertaining to the use of mycotoxins to the U.N. Group of Experts investigating reports of chemical weapons use.

Under Secretary of State for Political Affairs Stoessel held a press conference in Washington on September 14 and provided a detailed press backgrounder on the new evidence.

Secretary Haig raised U.S. concerns about the new evidence pertaining to the use of lethal mycotoxins in Southeast Asia and about the 1979 Sverdlovsk anthrax incident with Soviet Foreign Minister Gromyko during their bilateral consultations at the United Nations in New York.

October 1981

Following up the Haig/Gromyko discussions, detailed bilateral demarches were made to the Soviets in Washington by Acting Arms Control and Disarmament Agency Director Grey, and a followup in Moscow by the U.S. Deputy Chief of Mission, on the general subject of Soviet Biological Warfare Convention compliance and specific U.S. concerns regarding the 1979 Sverdlovsk anthrax incident and the evidence of the use of trichothecene mycotoxins in Southeast Asia. The Soviets rejected U.S. concerns once again in their formal response in November.

An interagency team of political, technical, and intelligence officers was dispatched to Europe to brief the allies about the new evidence of the use of lethal mycotoxins in Southeast Asia.

A delegation of U.S. Government political, technical, and medical experts appeared before the U.N. Group of Experts to respond to questions pertaining to the U.S. submission on September 14 of new evidence concerning the use of lethal mycotoxins in Southeast Asia.

November 1981

The U.N. Group of Experts investigating reports of chemical weapons use traveled to Thailand to visit refugee camps and interview and examine survivors and eyewitnesses of chemical attacks in Laos and Kampuchea. While there, the experts also obtained samples from alleged chemical attacks and samples of vegetation and blood from refugees exposed to chemical attacks.

Richard Burt, Director of the Bureau of Politico-Military Affairs, in testimony before the Congress, announced the results of analyses of additional samples of chemical warfare use revealing the presence of high levels of mycotoxins and the results of analyses of control samples from Southeast Asia which were found to contain *no* mycotoxins.

The United States submitted a report on its analyses of chemical warfare use samples from both Kampuchea and Laos, which were found to contain high levels of mycotoxins, to the U.N. Group of Experts investigating reports of chemical weapons use.

Demarches were made to the Vietnamese in New York and to the Lao in Vientiane regarding the evidence of the use of lethal mycotoxins in the conflicts in Kampuchea and Laos. Both the Vietnamese and the Lao rejected the evidence and denied the validity of U.S. concerns.

December 1981

The U.N. Secretary General submitted the Report of the U.N. Group of Experts investigating reports of chemical weapons use (A/36/613). The report was inconclusive and stated that the group had been unable to carry out all the actions it had *intended* (i.e., on-site visits to Afghanistan, Laos, and Kampuchea) due to the refusals to cooperate of the countries concerned, and that it had been unable to complete some of the actions it had *planned* (e.g., on-site visits to Pakistan, analysis of the samples obtained in Thailand) in the time available.

With the full and active support of the United States, the West, and others, the U.N. General Assembly adopted a resolution (A/36/96 C) extending for another year the mandate of the U.N. Secretary General's Group of Experts investigating reports of chemical weapons use. The vote on the resolution was 86 in favor to 20 opposed, with 32 abstentions.

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This report represents an effort of the U.S. Government to correct the first deficiency and to ameliorate the second to the extent possible. In preparation of this report, all of the information available to the U.S. Government on chemical weapons use in Laos, Kampuchea, and Afghanistan was assembled in one place. This information was again reviewed, analyzed, cross-indexed, and organized in a coherent fashion. Based upon this comprehensive analysis, a set of conclusions were drawn, conclusions which have since been reviewed and agreed on without qualification by every relevant agency of the U.S. Government.

The evidence upon which this report is based is of several kinds, including:

- Testimony of those who saw, experienced, and suffered from chemical weapons attacks;
- Testimony of doctors, refugee workers, journalists, and others who had the opportunity to question large numbers of those with firsthand experience of chemical warfare;
- Testimony of those who engaged in chemical warfare or were in a position to observe those who did;
- Scientific evidence, based upon the analysis of physical samples taken from sites where attacks had been conducted;
- Documentary evidence from open sources; and
- Intelligence derived from "national technical means."

These sources provide compelling evidence that tens of thousands of unsophisticated and defenseless peoples have for a period of years been subjected to a campaign of chemical attacks. *Taken together, this evidence has led the U.S. Government to conclude that Lao and Vietnamese forces, operating under Soviet supervision, have, since 1975, employed lethal chemical and toxin weapons in Laos; that Vietnamese forces have, since 1978, used lethal chemical and toxin agents in Kampuchea; and that Soviet forces have used a variety of lethal chemical warfare agents, including nerve gases, in Afghanistan since the Soviet invasion of that country in 1979.*

The implications of chemical warfare in Afghanistan and Southeast Asia are painful to contemplate but dangerous to ignore. This activity threatens not only the peoples of those isolated regions but the international order upon which the security of all depends. Those who today suffer chemical warfare against their homelands are powerless to stop it. The prohibitions of international law and solemn agreement are not self-enforcing. Only an alert and outspoken world community, intent to maintain those standards of international behavior it has so painfully achieved and so tenuously established, can bring sufficient pressure to bear to halt these violations of law and treaty. It is hoped that publication of this report will be one step in this process, the end result of which will be the cessation of chemical warfare and the strengthening of the rule of law in the affairs of nations.

KEY JUDGMENTS

Laos. The U.S. Government has concluded from all the evidence that selected Lao and Vietnamese forces, under direct Soviet supervision, have employed lethal trichothecene toxins and other combinations of chemical agents against H'Mong resisting government control and their villages since at least 1976. Trichothecene toxins have been positively identified, but medical symptoms indicate that irritants, incapacitants, and nerve agents also have been employed. Thousands have been killed or severely injured. Thousands also have been driven from their homeland by the use of these agents.

Kampuchea. Vietnamese forces have used lethal trichothecene toxins on Democratic Kampuchean (DK) troops and Khmer villages since at least 1978. Medical evidence indicates that irritants, incapacitants, and nerve agents also have been used.

Afghanistan. Soviet forces in Afghanistan have used a variety of lethal and nonlethal chemical agents on *mujahidin* resistance forces and Afghan villages since the Soviet invasion in December 1979. In addition, there is some evidence that Afghan Government forces may have used Soviet-supplied chemical weapons against the *mujahidin* even before the Soviet invasion. Although it has not been possible to verify through sample analysis the specific agents used by the Soviets, a number of Afghan military defectors have named the agents brought into the country by the Soviets and have described where and when they were employed. This information has been correlated with other evidence, including the reported symptoms, leading to the conclusion that nerve agents, phosgene oxime, and various incapacitants and irritants have been used. Other agents and toxic smokes also are in the country. Some reported symptoms are consistent with those produced by lethal or sublethal doses of trichothecene toxins, but this evidence is not conclusive.

The Soviet Connection. The conclusion is inescapable that the toxins and other chemical warfare agents were developed in the Soviet Union, provided to the Lao and Vietnamese either directly or through the transfer of know-how, and weaponized with Soviet assistance in Laos, Vietnam, and Kampuchea. Soviet military forces are known to store agents in bulk and move them to the field for munitions fill as needed. This practice also is followed in Southeast Asia and Afghanistan, as evidenced by many reports which specify that Soviet technicians supervise the shipment, storage, filling, and loading onto aircraft of the chemical munitions. The dissemination techniques reported and observed evidently have been drawn from years of Soviet chemical warfare testing and experimentation. *There is no evidence to support any alternative explanation, such as the hypothesis that the Vietnamese produce and employ toxin weapons completely on their own.*

METHODOLOGY

The judgments of this study were arrived at through a rigorous analytical process.

- Every relevant piece of information on reported chemical warfare incidents was reviewed, recorded, and tabulated. Numbers of attacks and deaths were screened for possible duplication. Extensive data on the Soviet chemical and biological warfare program also were reviewed.
- All the test data on physical evidence available to the U.S. Government—including environmental samples and background controls—were reviewed.
- A scientific report on toxins, which concluded that trichothecenes probably were among the agents used in Southeast Asia, was prepared.
- The medical evidence was analyzed, drawing on all available information from Southeast Asia and Afghanistan and incorporating the findings of a Department of Defense medical team, which concluded that at least three types of agents were used in Laos.
- Extensive consultations were held with government and nongovernment scientists and medical authorities, many of whom were asked to review the evidence. Experts from other countries also were consulted.

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After the data were organized to permit comparative analysis, the study focused on three separate questions.

- Have lethal and other casualty-producing agents been used in Southeast Asia and Afghanistan?
- What are these agents, and how and by whom are they employed?
- Where do these agents originate, and how do they find their way to the field?

Although the evidence differs for each country, the analytical approach was the same. Testimony of eyewitnesses—date, place, and type of attack—was matched against information from defectors, journalists, international organizations, and sensitive information that often pinpointed the time and place of chemical attacks. In addition, information on military operations in the areas where chemical attacks had been reported was examined to establish whether air or artillery strikes took place or whether there was fighting in the areas where chemical agents reportedly were used. *In all three countries, instances were identified in which eyewitness accounts could be correlated directly with information from other sources on military operations in progress.*

There is no evidence of any systematic propaganda campaign by either the H'Mong in Laos or the Afghan resistance forces to promote the allegation that chemical agents have been used on their people. On the other hand, there were early indications that Pol Pot's Democratic Kampuchean resistance did engage in an organized propaganda campaign on chemical agent use. These indications made U.S. Government analysts cautious about accepting DK allegations, which increased markedly after the chemical attacks in Laos were publicized. For Kampuchea, therefore, special efforts were taken to confirm such allegations by analyzing sources of information that in no way could be considered part of a propaganda or deception campaign.

DISCUSSION OF FINDINGS

In September 1981, the U.S. Government declared publicly that toxins—poisonous chemical substances extracted from biological material—probably were the mysterious lethal agents used for many years in Laos and Kampuchea. The statement was prompted by the discovery of high levels of trichothecene toxins in a vegetation sample collected shortly after a March 1981 Vietnamese chemical attack in Kampuchea. This conclusion, however, rested on a much broader base of evidence than analysis of one sample.

By April 1980, the U.S. Government had already concluded that lethal agents almost certainly had been used against H'Mong tribespeople in Laos. There was less certainty then about the use of lethal agents in Kampuchea, mainly because of the already mentioned suspicions about the propaganda campaign of Pol Pot's Democratic Kampuchean forces, although their claims subsequently were shown to be valid. It was also concluded that chances were about even that lethal agents had been used in Afghanistan. There was little doubt by April 1980 that riot-control agents and some form of incapacitants had been used in all three countries. Since that April 1980 assessment, additional evidence has allowed a much firmer conclusion. There is now no doubt that casualties and deaths have resulted from chemical attacks in all three countries.

What Chemical Agents Are Being Used?

As soon as it was determined that chemical agents had been used, an effort was made to identify the specific agents. To do this it was necessary to collect and analyze at least one of the following: environmental samples contaminated with agents, the munitions used to deliver agents, or biological specimens from victims of an attack. A study by medical-toxicological experts of symptoms exhibited by individuals exposed to toxic agents provides a good indication of the general class of chemical agent used. Thus, the range of clinical manifestations from chemical agents, as reported by a U.S. Army investigative team in Thailand, resulted in the determination that nerve agents, irritants such as CS, and highly toxic hemorrhagic chemicals or mixture of chemicals were used in Laos.

Other medical-toxicological personnel who reviewed the evidence and conducted their own investigation reached the same conclusion. They further indicated that toxins such as the trichothecenes were a probable cause of the lethal hemorrhaging effect seen in Kampuchea and Laos. In many cases, symptoms reported by the Democratic Kampuchean forces in Kampuchea and the *mujahidin* in Afghanistan were similar to those reported by the H'Mong in Laos. Moreover, symptoms reported from Afghanistan and Kampuchea indicated that a highly potent, rapid-acting, incapacitant "knockout" chemical also was being used. *Mujahidin* victims and witnesses to chemical attacks reported other unusual symptoms, including a blackening of the skin, severe skin irritation along with multiple small blisters and severe itching, severe eye irritation, and difficulty in breathing—all of which suggests that phosgene oxime or a similar substance was used.

Collecting samples possibly contaminated with a toxic agent during or after a chemical assault is difficult under any circumstances but particularly when the assault is against ill-prepared people without masks or other protective equipment. Obtaining contaminated samples that will yield positive traces of specific chemical agents depends on many factors. These include the persistency of the chemical, the ambient temperature, rainfall, wind conditions, the medium on which the chemical was deposited, and the time, care, and packaging of the sample from collection to laboratory analysis.

Many traditional or known chemical warfare agents are nonpersistent and disappear from the environment within a few minutes to several hours after being dispersed. Such agents include the nerve agents sarin and tabun; the blood agents hydrogen cyanide and cyanogen chloride; the choking agents phosgene and diphosgene; and the irritant phosgene oxime. Other standard chemical warfare agents—such as the nerve agents VX and thickened soman and the blistering agents sulfur mustard, nitrogen mustard, and lewisite—may persist for several days to weeks depending on weather conditions.

The trichothecene toxins have good persistency but may be diluted by adverse weather conditions to below detectable concentrations. To maximize the chances of detection, sample collections need to be made as rapidly as possible after a chemical assault; as with many agents, this means minutes to hours. Under the circumstances of Southeast Asia and Afghanistan, such rapid collection has simply not been possible. Although many samples were collected, few held any realistic prospect of yielding positive results. It is fortunate that trichothecenes are sufficiently persistent and in some cases were not diluted by adverse weather conditions. Thus we were able to detect them several months after the attack.

Samples have been collected from Southeast Asia since mid-1979 and from Afghanistan since May 1980. To date, about 50 individual samples—of greatly varying types and usefulness for analytical purposes—have been collected and analyzed for the presence of known

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chemical warfare agents, none of which has been detected. Based on recommendations by medical and toxicological experts and findings of investigators from the U.S. Army's Chemical Systems Laboratory, several of the samples have been analyzed for the trichothecene group of mycotoxins. Four samples, two from Kampuchea and two from Laos, were found to contain high levels of trichothecene toxins. In addition, preliminary results of the analysis of blood samples drawn from victims of an attack indicate the presence of a trichothecene metabolite of T-2, namely HT-2.

A review of all reports indicates the use of many different chemical agents, means of delivery, and types of chemical attacks. The use of trichothecene toxins has been identified through symptoms and sample analysis. In some cases, however, the symptoms suggest other agents, such as nerve gas, which have not been identified through sample analysis. Significant differences as well as similarities have surfaced in the reports from the three countries. The evidence from each country, therefore, is described separately, with attention drawn to similarities where appropriate.

Laos

Reports of chemical attacks against H'Mong villages and guerrilla strongholds in Laos date from the summer of 1975 to the present (see Table 1). Most of the reports were provided by H'Mong refugees who were interviewed in Thailand and the United States. More than 200 interviews were carried out variously by U.S. Embassy officials in Thailand, a Department of Defense team of medical-toxicological experts (see Annex B), U.S. physicians, Thai officials, journalists, and representatives of international aid and relief organizations. According to the interviews, Soviet AN-2 and captured U.S. L-19 and T-28/41 aircraft usually were employed to disseminate toxic chemical agents by sprays, rockets, and bombs. In some cases, Soviet helicopters and jet aircraft were said to have been used.

The reports describe 261 separate attacks in which at least 6,504 deaths were cited as having resulted directly from exposure to chemical agents. The actual number of deaths is almost certainly much higher, since the above figure does not take account of deaths in attacks for which no specific casualty figures were reported. The greatest concentration of reported chemical agent use occurred in the area where the three provinces of Vientiane, Xiangkhoang, and Louangphrabang adjoin (see map). This triborder region accounted for 77% of the reported attacks and 83% of the chemical-associated deaths. Most of the reported attacks took place in 1978 and 1979. Since 1979, the incidence of chemical attacks appears to have been lower, but reported death rates among unprotected and untreated victims were higher. Only seven chemical attacks were reported in the fall of 1981, for example, yet 1,034 deaths were associated with those incidents.

TABLE 1

Laos: Summary of Reported Chemical Attacks and Associated Deaths, 1975-81

Time Period	Area	Attacks[a]	Deaths[b]
Summer 1975	Vientiane	2	25+
Fall 1976	Phou Bia	8	10
	Savannakhet	1	10
Winter 1976-77	Phou Bia	2	16
Spring 1977	Phou Bia	6	66+
	Khammouan	2	1
Summer 1977	Phou Bia	6	95
Fall 1977	Phou Bia	1	25
Winter 1977-78	Phou Bia	10	1,328+
	Savannakhet	6	224
Spring 1978	Phou Bia	34	969+
Summer 1978	Phou Bia	22	664+
Fall 1978	Phou Bia	19	572
Winter 1978-79	Phou Bia	5	15+
Spring 1979	Phou Bia	36	257+
Summer 1979	Phou Bia	5	239+
Fall 1979	Phou Bia	10	56
	Xaignabouri	2	24+
Winter 1979-80	Phou Bia	4	10+
Spring 1980	Phou Bia	3	24
Summer 1980	Phou Bia	6	187+
Fall 1980	Xaignabouri	1	12
	Phou Bia	7	88+
	Savannakhet	3	1+
Winter 1980-81	Xaignabouri	2	57
	Phou Bia	4	82
	Vientiane	1	1+
Spring 1981	Houaphan	2	?
	Phou Bia	7	218
	Vientiane	1	—
Summer 1981	Phou Bia	1	?
Fall 1981	Phou Bia	4	500+
	Khammouan	3	534+
		226	6,310+

[a] This tabulation omits 35 attack sites, accounting for 194 deaths, which could not be geographically located in the reports. The totals overall were 261 attacks and more than 6,504 deaths.

[b] A plus sign indicates that the report(s) of deaths gave a minimum figure. In some cases (shown with a question mark) deaths were reported, but no number was given. Other reports (signified with a dash) gave no information on fatalities.

The medical symptoms reportedly produced by the chemical agents are varied. According to knowledgeable physicians, the symptoms clearly point to at least three types of chemical agents—incapacitant/riot-control agents, a nerve agent, and an agent causing massive hemorrhaging. The last-named was positively identified as trichothecene toxins. This was announced publicly by Secretary Haig in September 1981.

In a number of the refugee reports, eyewitnesses described attacks as consisting of "red gas" or a "yellow cloud."

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Laos: Chemical Warfare Operational Areas

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Red gas was considered the more lethal. A former Lao Army captain stated that the "red gas" caused the H'Mong to die within 12 hours. An employee of an international organization interviewed victims of a September 15, 1979 attack in which nonlethal rounds preceded an attack by five or six "red gas" bombs that covered a 500-meter area. Persons within 30–100 meters of the circle died in 10 minutes after severe convulsions. Others had headaches, chest pains, and vomiting but did not die.

Every qualified interrogator who systematically interviewed the H'Mong refugees concluded that they had been subjected to chemical attacks. A U.S. Government medical team returned from Thailand in 1979 convinced that several unidentified chemical warfare agents had produced the symptoms described by the refugees. This evidence was expanded by testimony from a variety of sources, including that of a Lao pilot who flew chemical warfare missions before defecting in 1979. His detailed description of the Lao, Vietnamese, and Soviet program to use chemical agents to defeat the H'Mong resistance helped dispel any lingering suspicions that the refugees had fabricated or embellished the stories. The Lao pilot described the chemical rocket he had fired as having a more loosely fitting warhead than a conventional rocket. (His account appears in Annex A.)

In 1977, a H'Mong resistance leader found a U.S. 2.75-inch rocket* with a modified Soviet warhead that fits the Lao pilot's description. Other sources reported that U.S. 2.75-inch rockets were fitted with Soviet-supplied lethal chemical warheads by Soviet and Vietnamese technicians at facilities in Vientiane as well as in Xiangkhoang and Savannakhet Provinces. Munitions storage facilities suitable for storing chemical agents and weapons have been identified in each of these provinces. The aircraft types—AN-2s, L-19s, and T-28/41s—most often reported by the H'Mong refugees as being used to deliver chemical agents have been identified as based on airfields in northern Laos throughout this period. A special Lao Air Force unit is responsible for chemical rockets. The unit is commanded by a Soviet-trained Lao and has a Soviet rocket expert attached as an adviser.

* During withdrawal of U.S. forces from Vietnam, thousands of these fell into Vietnamese hands.

Obtaining additional data for Laos has been difficult because of the nature of the fighting there. There have been few major operations. The reports reflect numerous minor engagements between the opposing forces. In nearly all cases, the chemical use reported has been directed against villages, in the absence of obvious combat operations. This lends support to the Lao pilot's claim that the Vietnamese and Lao military commands were engaged in a "H'Mong extermination" campaign.

Of particular interest are the circumstances surrounding the collection of two physical samples found to contain lethal toxins. The first was collected after a March 13, 1981 attack on a village between the villages of Muong Chai and Phakhao in the Phou Bia region. In this case, a large two-engine plane reportedly sprayed a mist of a moist, yellow, sticky substance; two villagers and all village animals died. The second sample is from Ban Thonghak, another village in the Phou Bia region, collected following an April 2, 1981 attack in which a jet aircraft reportedly sprayed a yellow substance; 24 of the 450 villagers died. In the spring of 1981, seven separate chemical attacks, resulting in 218 deaths, were reported to have occurred in this region.

It is significant that these attacks took place following a period of escalation in overall resistance activities in the Phou Bia area in the winter of 1980–81. During that period, joint suppression operations by Lao People's Liberation Army and Vietnamese Army forces had achieved only limited success, perhaps spurring both forces on to greater effort. The more intense use of chemical weapons may have been part of this effort.

Evidently the fact that chemical agents were being used in Laos was not widely known among units of the Lao Army. In June 1981, a group of refugees from a village in Vientiane Province reached Thailand and described attacks against them carried out a month earlier by helicopters "dropping poison" into their water supply. Lao field units subsequently entered the village and were surprised at the sight of many villagers still suffering from symptoms of acute poisoning. According to a villager, when the Lao military personnel saw the "small yellow grains" spread around the village, they were convinced that toxic chemicals had been used on the village and requested medical assistance for those villagers still suffering from nausea and bloody diarrhea.

In a December 15, 1981 press conference in Beijing, former Lao Health Ministry Bureau Director Khamsengkeo Sengsathit—who had defected to China—confirmed that chemical weapons were being used "in the air and on the ground" in Laos, killing "thousands." He asserted that the Vietnamese alone were using such weapons, keeping the matter secret from the Lao. He also stated that 3,000 Soviet advisers were in Laos and "have taken control" of the Lao Air Force, while 40,000–50,000 Vietnamese troops had "reduced Laos to the status of a colony."

Kampuchea

Since October 1978, radio broadcasts, press releases, and official protests to the United Nations by the Democratic Kampuchea leadership have accused the Vietnamese and the Hanoi-backed People's Republic of Kampuchea regime of using Soviet-made lethal chemical agents and weapons against DK guerrilla forces and civilians. DK allegations for a time were the only source of information concerning chemical warfare attacks in Kampuchea. In November 1979, however, the guerrilla forces of the Khmer People's National Liberation Front reported that the Vietnamese had attacked them with a tear gas which, from their description, resembled the riot-control agent CS. Subsequently, Thai officials, Democratic Kampuchea informants and refugees, Vietnamese Army defectors, U.S. and Thai medical personnel, officials of international aid and relief organizations, and Canadian and West European officials also have implicated the Vietnamese in the offensive use of lethal and incapacitating chemical agents in Kampuchea.

There are reports of 124 separate attacks in Kampuchea from 1978 to the fall of 1981 in which lethal chemicals caused the deaths of 981 persons (see Table 2). The mortality figure represents a minimum because some reports state only that there were deaths and do not provide a number. The earliest reports cite attacks in Ratanakiri Province, in the northeastern corner of the country (see map). Reports from 1979 to the present show the use of lethal chemicals primarily in the provinces bordering Thailand. The greatest use of chemical agents apparently has been in Battambang Province, with 51 reported incidents; Pursat Province has experienced the next highest frequency, with 25

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TABLE 2

Kampuchea: Summary of Reported Chemical Attacks and Associated Deaths, 1978–81

Time Period	Area	Attacks	Deaths[a]
1978	Ratanakiri	5	?
Summer 1979	Kompong Speu	4	37
Fall 1979	Siem Reap	1	—
	Battambang	4	22+
	Pursat	2	1+
	Koh Kong	2	6+
	Kampot	1	3
	Kompong Chhnang	2	118
Winter 1979–80	Battambang	12	64+
	Pursat	5	21+
	Koh Kong	2	4
Spring 1980	Battambang	3	20+
	Pursat	8	24+
	Koh Kong	5	13
Summer 1980	Siem Reap	1	82+
	Battambang	3	23+
	Pursat	2	7
	Koh Kong	3	—
Winter 1980–81	Battambang	8	—
	Pursat	2	3
Spring 1981	Preah Vihear	1	—
	Battambang	12	163+
	Pursat	3	42+
	Koh Kong	1	—
	Kampot	1	—
Summer 1981	Battambang	3	7+
	Kompong Thom/Cham	1	—
Fall 1981	Siem Reap	16	305
	Battambang	6	16
	Pursat	3	—
	Koh Kong	1	—
	Kampot	1	—
		124	981

[a] A plus sign indicates that the report(s) of deaths gave a minimum figure. In some cases (shown with a question mark) deaths were reported, but no number was given. Other reports (signified with a dash) gave no information on fatalities.

reported incidents. These numbers are consistent with the overall high level of military activity reported in the border provinces.

A review of information from all sources provides direct and specific support for 28 of 124 reported attacks. There is, in addition, some evidence that in all reported instances some form of attack took place. This evidence includes reports of troop movements, supply transfers, operational plans, postoperation reporting, and air activity. It indicates that military activity took place at the time and place of every incident reported to involve lethal chemical agents. In some cases, it provides strong circumstantial evidence that the action involved chemical substances—for example, the movement of chemicals and personal protection equipment into the area.

There is no doubt that in late 1978 and 1979 the Vietnamese, and what later became the People's Republic of Kampuchea forces, made at least limited use of riot-control chemicals and possible incapacitating agents against both Communist and non-Communist guerrilla forces in Kampuchea. The chemicals used probably included toxic smokes, riot-control agents such as CS, and an unidentified incapacitating agent that caused vertigo and nausea and ultimately rendered victims unconscious with no other signs or symptoms.

In March 1979, during Vietnamese operations against Khmer Rouge forces in the Phnom Melai area, a Vietnamese Army private, who later defected, observed the following activities related to chemical warfare. During the fighting, all regiment (740th) troops were issued gas masks. However, the 2nd Battalion, a "border defense unit," was not issued masks. This unit was in the Phnom Melai area and was virtually surrounded by Khmer Rouge forces. At another point in the battle, the regiment's troops were ordered to don masks. The Vietnamese Army private reported that he saw two Soviets (Caucasians) fire a DH-10 (a hand-held weapon identified by the private's comrades). He was about 50 meters from the firing point. The weapon at impact, which he was able to observe from his position, gave off clouds of white, gray, and green gas/smoke. His signal unit subsequently passed a message reporting that there were 300 dead, including the unprotected Khmer Rouge and Vietnamese of the border defense forces' 2nd Battalion. The corpses reportedly had traces of white and green powder on their faces and clothes. Their faces were contorted, with eyes wide open. No blood was seen. (A H'Mong resistance leader described an incident in 1981 in which two Soviet soldiers fired a hand-held weapon that dispersed a similar lethal agent.)

Starting in February 1980, reports revealed that the Vietnamese were using 60 mm mortars, 120 mm shells, 107 mm rockets, M-79 grenade launchers filled with chemical agents, as well as munitions delivered by T-28 aircraft. According to the DK, the chemicals used were green and yellow and powderlike in appearance. In some instances the gas was described as yellow or white. The symptoms described were tightening of the chest, disorientation, vomiting, bleeding from the nose and gums, discoloration of the body, and "stiffening" of the teeth. In July 1980, the DK described artillery attacks that produced a black smoke causing itchy skin, weakness, skin lesions, and in some cases decaying skin and blisters. In December 1980, the Vietnamese were once again firing chemical artillery shells, and it was believed that poison chemicals were being brought into Thailand's border region. By March 1981, the Democratic Kampuchea forces had reported numerous attacks directed against them with lethal chemical agents and the poisoning of food and water.

U.S. analysis of contaminated vegetation samples collected within hours of a March 1981 attack showed high levels of three trichothecene toxins in a combination that would not be expected to be found in a natural outbreak in this

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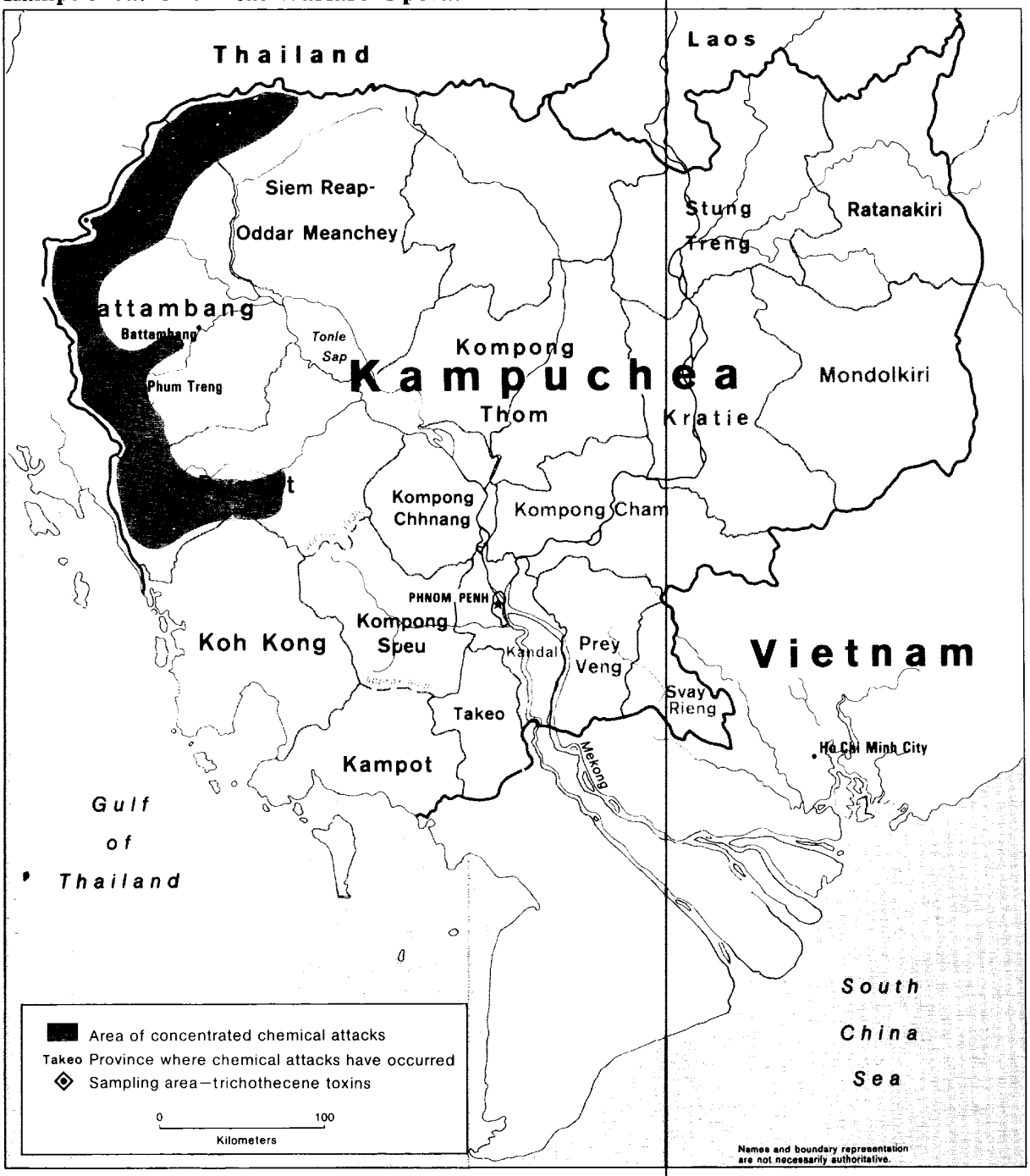
Kampuchea: Chemical Warfare Operational Areas



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environment. At the levels found on the vegetation, the three trichothecenes would produce vomiting, skin irritations and itching, and bleeding symptoms. Water samples taken from the area of the same attack also contained trichothecene toxins. Control samples from nearby areas confirmed that these toxins were not indigenous to the locale. (Details on the sample analysis appear in Annex D.)

There also is ample evidence of military activity at the place and time of the acquisition of the samples. Vietnamese Army defectors described plans for multiregimental sweep operations to be conducted along the border in northwestern Battambang Province before the end of the dry season in May. Actual fighting, however, continued to be characterized by guerrilla tactics on both sides, including, according to a Vietnamese Army defector, "staging ambushes, laying minefields, and use of deception." Indeed, Democratic Kampuchean resistance forces were ordered to avoid large-scale operations and to limit combat operations to scattered sapper attacks. Such information is consistent with other reports of Vietnamese Army forces spreading toxic chemicals in streams, along roadsides, and around villages and firing toxic gas shells against enemy positions. The Phnom Melai sector, where Phnom Mak Hoeun is located, was described as an "anthill of DK activity," and actions reported during March were "sporadic firefights" around Phnom Mak Hoeun involving the Vietnamese Army's 2nd Battalion, 2nd Border Security Regiment.

In Kampuchea, as in Laos, the period of late 1980 through spring 1981 was one of intensified Vietnamese operations to suppress the resistance and break the will of the opposing forces. In July 1981, trucks loaded with blue sacks filled with white powder were being moved by the Vietnamese into the Pailin, Battambang, and Siem Reap areas. Vietnamese soldiers told villagers that the chemicals caused blindness, hemorrhaging, and vomiting.

Additional evidence was derived from blood samples drawn from victims of Vietnamese chemical use that occurred on September 19, 1981 in the Takong area. Takong is in the same general area as Phnom Mak Hoeun—that is, the central region of Battambang Province near the Thai border. Although there is no independent confirmation of the accounts of the attack, American medical personnel visiting a DK field hospital examined the victims and obtained the blood samples. Analyses of these samples suggested the use of trichothecenes. (Blood analysis results also appear in Annex D.)

According to the DK soldiers affected, the chemicals used in the September 19 Takong attack were dispersed as a gas or powder and as a poison to water. The gas or powder was released from containers by tripwires in the area of the rear forces. This description is consistent with the other reporting for this area and time.

Thailand also has been concerned about chemical attacks against its own forces and civilian population. In March 1981, one Thai died from poisons placed by Vietnamese troops, and others became ill after suffering bleeding from the nose and mouth. In May 1981, Thai forces captured two Vietnamese as they were attempting to poison the water supply in a Kampuchean relocation camp in Thailand. The poison was analyzed by the Thai and found to contain lethal quantities of cyanide. Many reports indicate that it is common practice for Vietnamese units to poison water and food used by the DK forces.

The Soviet Connection in Southeast Asia

Much of the Soviet interest in Southeast Asia is dictated by their rivalry with China and their close alliance with the Vietnamese. Regional Communist forces have been strengthened to contain Chinese influence and deter military incursions. The area of northern Laos between Vientiane and the Chinese border—where the H'Mong hill tribes have stubbornly resisted and harassed Vietnamese forces—is strategically significant to the Vietnamese because it adjoins a hostile China. In the last few years the Vietnamese have expanded their military construction and strengthened their forces in Laos which now number 50,000.

Initially there was a tendency to interpret the Soviet role as strictly advisory. Now, however, there is considerable evidence to suggest that the Soviets are far more involved in the Lao and Vietnamese chemical warfare program than was assumed earlier. An estimated 500 Soviet military advisers provide maintenance assistance and technical support, actually running the Lao Air Force, and give advanced training to Lao personnel in conventional as well as chemical warfare.

The Soviets have had advisers and technicians working in Vietnam and Laos for many years and in Kampuchea since 1979. However, it was not until early 1979 that evidence surfaced on the Soviets' direct involvement in chemical warfare activities. For example, the Lao Army chemical section in Xiangkhoang prepared Soviet-manufactured chemical items for inspection by a Soviet military team on February 7, 1979. A seven-man team of Soviet chemical artillery experts, accompanied by Lao chemical officers, inspected chemical supplies and artillery rounds at the Xeno storage facility in Savannakhet on June 1, 1979. One report stated that the Soviets would be inspecting the same chemical explosives used to suppress the H'Mong in the Phou Bia area.

In addition to this information, H'Mong accounts have described Soviet advisers and technicians participating in the preparation of the chemical weapons for the attacks on the H'Mong villages. H'Mong eyewitnesses claim to have seen "Caucasian pilots" in aircraft, and one H'Mong report states that a downed Soviet aircraft was discovered in the jungle along with a dead Soviet pilot. In November 1981, a H'Mong resistance leader described how Soviet soldiers fighting with the Lao Army fired handheld weapons that dispersed a lethal agent over a 300-meter area. Several Lao defectors have reported seeing Soviet advisers present when aircraft were loaded with chemical-agent rockets.

In July 1981, a Soviet shipment of wooden crates filled with canisters described by the Vietnamese as "deadly toxic chemicals" was unloaded at the port of Ho Chi Minh City. This incident further corroborates the judgment that the Soviets have been shipping chemical warfare materiel to Vietnam for some time. During the unloading, Vietnamese soldiers were caught pilfering the wooden crates containing the canisters. The soldiers dropped one of the wooden cases and intentionally broke it open; they wanted to determine if its contents were edible or valuable for pilferage. When a soldier broke the nylon seal and attempted to pry open a canister, special security personnel isolated the area and told the soldiers that the canisters contained deadly toxic substances from the U.S.S.R. The wooden crates, each weighing 100 kilograms, were loaded on military trucks and taken under special guard to the Long Binh storage depot.

This incident is only one in a series involving Soviet chemical warfare materiel dating back several years. In 1975, for example, a Soviet captain of a diving support craft engaged in salvaging a sunken ship in the Black Sea, which had been transporting Soviet military supplies to Vietnam, said that

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his divers came in contact with toxic chemicals, and a special Soviet salvage unit took over the operation after the divers became very ill. The salvage operations, conducted by the ASPTR-12 Salvage, Rescue, and Underwater Technical Services Group based in Odessa, were monitored by high-ranking Soviet naval officers.

The operation began with the removal of tractors and helicopters which cluttered the deck of the ship and prevented access to hold hatches. Once the surface clutter was removed, the divers attempted to enter the holds. At this point, however, operations had to be suspended temporarily because of a violent outbreak of chemical poisoning among the divers. Contact with the unidentified chemicals resulted in reddish welts 1-3 centimeters in diameter on exposed skin and was accompanied by severe headaches, nausea, and a general feeling of fatigue. The symptoms disappeared on their own after 3-5 days of rest. At this point, military authorities took over from the ASPTR-12 divers, who were temporarily withdrawn from the project. Soviet naval divers were sent down and determined that the source of poisoning was chemical seepage from an open hatch of one of the holds. The hatch was promptly sealed, and the salvage operation was once more assigned to ASPTR-12 divers who resumed work and retrieved ammunition and an assortment of other equipment. Once this was done, the military took over permanently. The ship was raised without removing the poisonous chemicals and towed to an Odessa shipyard where the chemicals were unloaded by military personnel. The ship was then broken up and scrapped. The entire operation took about 3 years to complete.

As another example of Soviet involvement, two Vietnamese corporals, from the 337th and 347th Vietnamese Army divisions, have stated that Soviet-supplied chemical weapons were stored in caves near Lang Son in February 1979. Although their Vietnamese units were issued gas masks, they were told that Soviet-supplied chemical weapons would not be used unless the Chinese initiated chemical warfare. As late as February 1981, a team of uniformed Soviet military advisers was attached to the corps headquarters. The team leader was a senior Soviet colonel. The Soviets were involved in training corps personnel in the use of Soviet-supplied weapons and equipment, including chemical artillery shells and gas masks. The Soviet team often inspected defensive positions and observed training maneuvers.

Afghanistan

Attacks with chemical weapons against the *mujahidin* guerrillas in Afghanistan were reported as early as 6 months before the Soviet invasion on December 27, 1979. The information specifies that Soviet-made aircraft were used to drop chemical bombs, with no clear identification of Soviet or Afghan pilots or of the specific agents used. On November 16, 1979, chemical bombs reportedly were dropped along with conventional air munitions on targets in Farah, Herat, and Badghisat Provinces by Soviet-supplied Afghan IL-28 bombers based at Shindand. A number of Afghan military defectors have stated that the Soviets provided the Afghan military with chemical warfare training

TABLE 3

Afghanistan: Summary of Reported Chemical Attacks and Associated Deaths, 1979-81

Time Period	Province	Attacks[a]	Deaths[b]
Summer 1979	Badakhshan	1	2,000[c]
	Parvan	1	8
	Bamian	1	—
Fall 1979	Konarha	1	350
	Farah	1	?
	Herat	1	?
	Badghisat	1	?
Winter 1979-80	Badakhshan	5	130+
	Takhar	1	—
	Konarha	2	10+
	Nangarhar	1	?
	Bamian	1	?
Spring 1980	Badakhshan	1	1+
	Konarha	2	?
	Oruzgan	1	—
	Qandahar	1	—
Summer 1980	Nangarhar	2	1
	Vardak	1	3
	Herat	2	300+
	Kabul	2	—
Fall 1980	Konarha	1	?
	Lowgar	1	4
	Ghazni	1	100
Winter 1980-81	Lowgar	2	?
Spring 1981	Parvan	2	—
	Lowgar	3	—
	Ghazni	2	?
	Qandahar	1	—
Summer 1981	Nangarhar	2	?
	Qandahar	2	16
	Herat	1	119
		47	3,042

[a] This tabulation omits some attacks described in the text because they could not be dated or located with high confidence.

[b] A plus sign indicates that the report(s) of deaths gave a minimum figure. In some cases (shown with a question mark) deaths were reported, but no number was given. Other reports (signified with a dash) gave no information on fatalities.

[c] The quality of reporting for this period is not as good as the information that became available after the Soviet invasion. We are concerned that this unusually high figure may reflect an accumulation of deaths from several incidents and not the single attack indicated. For example, reports were received describing over 1,000 deaths in Bamian Province in June-July 1979. An Afghan military officer reported seeing the bodies of many *mujahidin* in Panjsher Valley in August 1979 after a chemical attack and stated that many had been killed. An Afghan civil engineer reported hearing that many deaths resulted from a chemical attack in the Jalalabad area, also in the summer of 1979. Because we could not obtain supporting evidence, these reports were not included. Although sufficient evidence exists to conclude that Afghan Government forces used chemical weapons, mainly bombs, from June to December 1979, no survivors or eyewitness accounts of these attacks are available to determine the type of agent and symptoms.

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Afghanistan: Chemical Warfare Operational Areas

as well as supplies of lethal and incapacitating agents.

For the period from the summer of 1979 to the summer of 1981, the U.S. Government received reports of 47 separate chemical attacks with a claimed death toll of more than 3,000 (see Table 3). Of the 47 reports, 36 came from Afghan Army deserters, *mujahidin* resistance fighters, journalists, U.S. physicians, and others. For 24 of the reported attacks, there is additional independent evidence supporting allegations of chemical attacks. In seven instances, further individual reporting exists. Evidence for 20 of the reported incidents comes from information on Soviet or Afghan Army combat operations in progress in areas and at times approximating those of a reported chemical attack (see map).

The reports indicated that fixed-wing aircraft and helicopters usually were employed to disseminate chemical warfare agents by rockets, bombs, and sprays. Chemical-filled landmines were also reportedly used by the Soviets. The chemical clouds were usually gray or blue-black, yellow, or a combination of the colors.

Symptoms reported by victims and witnesses of attacks indicate that nonlethal incapacitating chemicals and lethal chemicals—including nerve agents, phosgene or phosgene oxime, possibly trichothecene toxins, and mustard—were used. Medical examinations of some of the victims include reports of paralysis, other neurological effects, blisters, bleeding, and sometimes death. While none of the agents being used in Afghanistan has been positively identified through sample analysis, there is no doubt that the agents being used are far more toxic than riot-control agents such as CN and CS or even adamsite.

Several descriptions of the physiological action of a chemical agent or of the condition of the corpses of victims were particularly unusual. In one, victims were rapidly rendered unconscious for 2–6 hours and had few aftereffects. In another, the bodies were characterized by abnormal bloating and blackened skin with a dark-reddish tinge, and the flesh appeared decayed very soon after death. In a third incident, three dead *mujahidin* guerrillas were found with hands on rifles and lying in a firing position, indicating that the attacker had used an extremely rapid-acting lethal chemical that is not detectable by normal senses and that causes no outward physiological responses before death.

Shortly after the Soviet invasion, many reports were received that both Soviet and Afghan forces were using various types of chemical agents. Ten separate chemical attacks, resulting in many deaths, were reported in the first 3 months of 1980. These reports came from northeastern Afghanistan and provide the highest percentage of reported deaths. During the mid-January to February 1980 period, helicopter attacks were reported in northeastern Afghanistan in which a grayish-blue smoke resulted in symptoms similar to those

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described by the H'Mong refugees from Laos (e.g., heavy tearing or watering of eyes; extensive blistering and discoloration of the skin, later resulting in large sheetlike peeling; swelling in the areas affected by the blister; and finally numbness, paralysis, and death). Medical reports from examinations in Pakistan of refugees from a large attack in the upper Konar Valley in February 1980 described red skin and blisters containing fluid described as "dirty water." Refugees estimated that about 2,000 people were affected after contact with a dirty yellow cloud.

By spring and summer of 1980, chemical attacks were reported in all areas of concentrated resistance activity. Many reports from different sources strongly support the case that irritants were used to drive the insurgents into the open to expose them to attack with conventional weapons and incapacitants to render them tractable for disarming and capture. On several occasions in April 1980, for example, Soviet helicopter pilots dropped "gas bombs" on insurgents, evidently to drive them from caves.

A Dutch journalist, Bernd de Bruin, published an eyewitness account of two chemical attacks occurring in the Jalalabad area on June 15 and June 21, 1980 (*Niewsnet,* August 2, 1980). He filmed an MI-24 helicopter dropping canisters that produced a dirty yellow cloud. A victim with blackened skin, discolored by extensive subcutaneous hemorrhaging, was photographed in the village 5 hours after the attack. The journalist evidently was exposed because he developed blisters on his hands and a swollen and itchy face. He also was exposed in the second attack, and it took about 10 days for him to recover from skin lesions, nausea, diarrhea, and stomach cramps.

An Afghan insurgent provided an eyewitness account of a July 6, 1980 attack on a village 10 kilometers east of Darae Jelga in Vardak Province. He reported that a Soviet MI-24 helicopter gunship dropped a bomb that, upon explosion, released a lethal chemical. A separate report confirmed that Soviet bombing attacks on villages in Vardak as well as Lowgar and Parvan Provinces were taking place during this period. In August 1980, information surfaced on a Soviet attack with chemical bombs on the village of Sya Wusan, 30 kilometers southeast of Herat, leaving 300 dead. It was during this time that the Soviet chemical battalion at Shindand set up an operational decontamination station.

Reports of chemical weapons use in 1981 essentially parallel 1980 reporting with respect to frequency and location of attack. Soviet helicopter units participated in chemical attacks from April 20 to April 29, 1981, in areas east and west of Kabul and in the Konar Valley, according to eyewitness accounts. These attacks were intended to drive personnel from sanctuaries, such as caves, in order to engage them with conventional fire. The munitions were described as Soviet 250-kilogram RBK cluster bombs. The Soviets have such a munition, which can be filled with chemical agents. Other reports described similar operations by helicopters north of Qandahar on April 24 and April 26, 1981.

A former Afghan MI-8 helicopter pilot said Soviet forces had used chemical weapons in Badakhshan, Qonduz, and Konarha. Chemicals in canisters that contained toxic gas, tear gas, and antirespiratory gas, which has an incapacitating effect by causing choking and difficulty in breathing, were manually pushed from the cargo compartment of helicopters. The pilot said that there also was a specific gas that is absorbed by the body and leaves the skin so soft that a finger can be punched through it. In one case, there was a wind shift, and Soviet and Afghan forces were seriously affected. Other sources also have described an incident where Soviet and Afghan forces were victims of their own gas attack.

The following sequence occurred in a small valley in Qandahar Province in early June 1981. According to an Afghan exile, Soviet combat groups engaged rebel forces in that valley during a 2-week period. The situation worsened for the Soviets, and an airstrike was conducted. The exile stated that a Soviet helicopter delivered a single rocket, releasing a chemical that killed 16 insurgents. Nearly all reports state that chemicals were delivered by aircraft or helicopters; a few reports describe chemical artillery rounds.

Before a sweep operation in the Konar Valley in September 1981, resistance leaders were told by an Afghan officer that the Soviets had four agents available but would use only the incapacitant which they could defend against with wet rags over the face. During the operation, Soviet helicopters conducted gas attacks in 25 different areas, using cylinders about 1.5 meters long and 60 centimeters in diameter that exploded 4-5 meters above the ground, releasing the incapacitating gas. Some victims lost consciousness, were paralyzed, and recovered, but others died, and unprotected areas of their skin turned dark green to blue-green.

An Afghan tribal leader recently described a Soviet chemical attack against a large resistance force in October 1981 near Maruf, about 100 kilometers east of Qandahar. Soviet helicopters dropped green cylindrical canisters (18 inches long, 3-4 inches in diameter) which, upon hitting the ground, emitted a greenish-yellow gas. According to the report, victims felt faint and dizzy; later their skin began to itch, and many lost consciousness. About 300 persons were affected by the gas and many died. Soviet ground forces captured many of the survivors. Other information on Soviet and *mujahidin* activities in the Qandahar area during this period confirms that this incident did in fact take place.

In February 1982, a member of the resistance, with considerable knowledge of Soviet weapons, told a U.S. official that the Soviets were using irritants, a hallucinogenic gas, and what he said was an apparent nerve gas. He described the "nerve agent" as an off-white powdery substance dispersed from helicopters generally during artillery or bombing attacks. Victims realize they have been exposed to chemical attack only when they become faint and dizzy. Subsequently, they begin to vomit and bleed from the eyes, nose, and mouth. Death occurs within a short time. The corpses are extremely relaxed, with no evidence of rigor mortis. Flesh and skin frequently peel off if an effort is made to move the bodies.

According to this account, survivors suffer aftereffects for about 6 months, including chest congestion and pain, dizziness, and mental agitation. The powder-like substance is more effective at lower altitudes where there is less wind to dilute the poison, and *mujahidin* groups have experienced fatality rates as high as 70%. Many survivors of chemical attacks in Laos and Afghanistan have exhibited the same long-term health problems described in this account.

Chemical defense battalions—standard in all Soviet divisions—are deployed with the three Soviet motorized rifle divisions operating in Afghanistan at Qonduz, Shindand, and Kabul. Soviet operational personnel decontamination stations were observed at several locations, and chemical decontamination field units were deployed during a sweep operation of the Konar Valley in eastern Afghanistan and near Shindand in the west in 1980. The operational deployment of decontamination units for personnel and equipment suggests that chemical battalions have supported offensive chemical use. In addition, Soviet personnel have been observed wearing chemical protective equipment. The Soviets have specifically tailored their forces in Afghanistan, in part

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because of logistical constraints; 5,000 troops and "nonessential" combat equipment were withdrawn, but the chemical battalions remain.

A Soviet military chemical specialist, captured by the *mujahidin*, gave his name as Yuriy Povarnitsyn from Sverdlovsk. During an interview, he said that his mission was to examine villages after a chemical attack to determine whether they were safe to enter or required decontamination. An Afghan pathologist who later defected described accompanying Soviet chemical warfare personnel into contaminated areas to collect soil, vegetation, and water samples after Soviet chemical attacks. According to firsthand experience of former Soviet chemical personnel, the Soviets do not require decontamination equipment in an area where chemical bombs are stored or loaded onto aircraft. Thus, deployment of this equipment in Afghanistan must be assumed to be associated with the active employment of casualty-producing chemical agents.

Afghan military defectors have provided information on ammunition and grenades containing phosgene, diphosgene, sarin, and soman and have described where and when some of them have been used. They also have revealed locations where these agents were stockpiled. The agents used, plus the time and location of the attacks, correspond with the refugee reports and recorded military operations.

The Soviet Union has stocked a variety of toxic chemical agents and munitions to meet wartime contingencies. Weapons systems capable of delivering chemical munitions available to Soviet forces in Afghanistan include artillery, multiple rocket launchers, and tactical aircraft.

Motivation for Using Chemical Weapons

In the course of this analysis, the question has been posed: Is there a military-strategic or tactical rationale for the systematic use of chemical weapons by conventional forces in Laos, Kampuchea, and Afghanistan? The military problems faced in these countries—viewed from the perspective of the Soviets and their allies—make the use of chemical weapons a militarily effective way of breaking the will and resistance of stubborn anti-government forces operating from relatively inaccessible, protected sanctuaries.

The Soviets have made a large investment in insuring that Vietnam and its clients succeed in extending their control over Indochina. For Vietnam, the H'Mong resistance in Laos is a major irritant to be removed as quickly and cheaply as possible. The use of chemical agents has played a major role in driving the H'Mong from their mountain strongholds, relieving Vietnamese and Lao ground forces of the need for costly combat in difficult terrain. Much of the H'Mong population that lived in the Phou Bia mountain region has been driven into Thailand, killed, or resettled.

In the mountainous areas of Afghanistan, where rebels are holed up in caves or other inaccessible areas, conventional artillery, high-explosive bombs, and napalm are not particularly effective. Many reports indicate that unidentified chemical agents have been used on such targets. Caves and rugged terrain in Laos and thick jungles in Kampuchea also have frustrated attempts to locate and destroy the resistance forces. Chemical clouds can penetrate the heavy forests and jungle canopy and seep into the mountain caves. Persistent agents linger in the area and cause casualties days and sometimes weeks after the attack. Unprotected forces and civilians have little or no defense against lethal agents like toxins, nerve gas, or blister agents.

Trichothecene toxins, which are known to have been used in Southeast Asia, have the added advantage of being an effective terror weapon that causes bizarre and horrifying symptoms. Severe bleeding, in addition to blisters and vomiting, has instilled fear in the resistance villages. Not only have the villagers and their animals been killed in a gruesome manner, but the vegetation and water also have been contaminated. Survivors are reluctant to return to their inhospitable homes and instead make the long and dangerous trek to camps in Thailand.

There is no clearcut explanation of why trichothecene toxins have been used in addition to irritants, incapacitants, and other traditional chemical warfare agents. Speculation suggests that they are probably cheaper to make and are readily available from Soviet stocks; they are probably safer and more stable to store, transport, and handle in a Southeast Asian environment, and they may require less protective equipment when being prepared for munitions. They are difficult to trace as the causative agent after an attack—as demonstrated by the length of time it took for the United States to detect them. Few laboratories in the world have the analytical capability to identify precisely the type and amount of trichothecene toxin in a sample of vegetation, soil, or water.

The Soviets may well have calculated that they and their allies could successfully deny or counter charges that chemical weapons had been used, recognizing that it would be especially difficult to compile incontrovertible evidence from inaccessible areas of Southeast Asia and Afghanistan. With respect to Kampuchea, they may also have calculated that, in view of the lack of international support for Pol Pot's resistance, chemical weapons could be used on his troops without significant international outcry.

In addition, the Soviet military very likely considers these remote areas as providing unique opportunities for the operational testing and evaluation of chemical weapons under various tactical conditions. Years of aerial and artillery chemical dispersion have undoubtedly provided the Soviets with valuable testing data. Southeast Asia has offered the Soviets an opportunity to test old agents that had been stockpiled for many years as well as more recently developed agents or combinations of agents. This conclusion is supported by information from foreign military officers who have attended the Soviet Military Academy of Chemical Defense in Moscow. According to their Soviet instructor, three types of chemical agents may be used during the "initial stages" of local wars: "harassing agents (CS, CN, DM), incapacitants such as psychochemicals (BZ) or intertoxins [sic—possibly enterotoxins], and herbicides." During the "decisive phase, lethal agents can be employed under certain circumstances." In a local war, "chemical weapons can be used to spoil enemy efforts to initiate operations, even if the enemy has not used them first." The foreign officers' accounts, including detailed descriptions of the Soviet chemical warfare program, support the conclusion that the Soviets consider chemical weapons an effective and acceptable means of warfare in local conflicts.

Insight into the Soviet bloc military perspective on the use of toxins is provided in the following passage from a 1977 East German military manual entitled *Textbook of Military Chemistry.*

> Toxins are designated as toxic agents which are produced by biological organisms such as micro-organisms, plants, and animals, and cannot themselves reproduce.
>
> By the middle of 1960 the toxins selected for military purposes were included among the biologic warfare agents. In principle, this was understood to mean only the bacterial toxins. Today it is possible to produce various toxins synthetically. Toxins with 10–12 amino acids can currently be synthesized in the laboratory. Toxins are not living substances and in this sense are chemicals. They thus differ fundamentally from the biological organisms so that they can be included among chemical warfare agents. As a result

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of their peculiarities they are designated simply as "toxin warfare agents." They would be used in combat according to the same principles and with the same methods used for chemical warfare agents. When they are used in combat the atmosphere can be contaminated over relatively large areas—we can expect expansion depths of up to 6 kilometers before the toxin concentration drops below lethal concentration 50 . . . the toxin warfare agents can be aerosolized. They can be used primarily in micro-bombs which are launched from the air or in warheads of tactical rockets. Toxin warfare agents concentrates can be applied with aircraft spray equipment and similar dispersion systems.

The Soviet designation for several pathogenic *Fusarium* products is "IIF (*iskusstvennyy infektsionny fon*), which stands for "artificial infection background." IIF devices are used in the Soviet Union deliberately to contaminate soil in experimental agricultural test areas with spores of disease-producing fungi. We are not certain if the IIF compounds include trichothecenes. Nor are we certain as to the intent of this agricultural research program. It is possible that these programs are designed to colonize soil with pathogenic organisms either to determine which crop varieties are most resistant to disease or, alternatively, to test eradication and control methods in infected soils. Elsewhere in the Soviet agricultural research program, however, it is known that there is widespread use of certain trichothecenes, including sprays from light aircraft. A capability exists within the Soviet Union for multi-ton production of light aircraft spray-delivered microbial products such as those described above.

Evidence accumulated since World War II clearly shows that the Soviets have been extensively involved in preparations for large-scale offensive and defensive chemical warfare. Chemical warfare agents and delivery systems developed by the Soviets have been identified, along with production and storage areas within the U.S.S.R. and continuing research, development, and testing activities at the major Soviet chemical proving grounds. Soviet military forces are extensively equipped and trained for operations in a chemically contaminated environment. None of the evidence indicates any abatement in this program. The Soviets have shown a strong interest in improving or enhancing their standard agents for greater reliability and effect. Their large chemical and biological research and development effort has led them to investigate other kinds of chemical warfare agents, particularly the toxins.

None of the four countries considered in this report—Vietnam, Laos, Kampuchea, and Afghanistan—has any known large-scale facility or organization for the manufacture of chemical and biological materials. Nor are they known to have produced even small quantities of chemical warfare agents or munitions. The technical problems of producing large quantities of weapons-grade toxins, however, are not so great as to preclude any of the four countries from learning to manufacture, purify, and weaponize these materials. It is highly unlikely, however, that they could master these functions without acquiring outside technical know-how.

ANNEX A

A Lao Pilot's Account

One of the most complete descriptions of chemical warfare activities in the 1976–78 period came from a Lao pilot who was directly involved in chemical warfare. The pilot, a former Lao People's Liberation Army (LPLA) officer who defected in 1979, reported that he flew captured L–19 and T–41 aircraft equipped to dispense toxic chemical agents on H'Mong villagers in the Phou Bia area of northern Laos. He said that the LPLA, in cooperation with the Vietnamese Army, had conducted chemical warfare operations in Laos since April or early May 1976. At that time, two Lao H–34 helicopters were flown between Long Tieng and the Phonsavan airfield, both in Xiangkhoang Province, on a series of flights to transport rockets to Phonsavan for storage.

Between June and August 1976, the LPLA launched attacks in the area of Bouamlong—in Xiangkhoang Province—a stronghold for remnants of the forces of former H'Mong Gen. Vang Pao. The LPLA used L–19 aircraft for rocket attacks in that area aimed at eliminating the H'Mong resisting government control. Lao crews responsible for loading rockets on the attack aircraft noted that they were not allowed to use the rockets that had been moved from Long Tieng to Phonsavan, even though Phonsavan was much closer to the Bouamlong target area than Long Tieng, where Lao aircraft had to rearm. The pilot said that, during nearly 3 months of flying missions against the Bouamlong area, he flew his L–19 aircraft to Long Tieng to be armed with rockets.

In late 1976, the pilot's L–19 aircraft was rearmed with rockets stored at Phonsavan. Initially, H–34 helicopters were used to transport the rockets from Phonsavan to a depot near the Ban Xon airfield (Vientiane Province), where the rockets were fitted onto racks of the L–19 aircraft for missions in the Phou Bia area; later, the rockets from Phonsavan were transported to Ban Xon by trucks. All U.S.-manufactured rockets were stored with the tip and canister kept apart; the two parts had to be joined before being fitted to the racks on the aircraft. The pilot observed, however, that all the rockets transported from Phonsavan to Ban Xon were already assembled.

As part of his routine flight activities, the pilot would check his aircraft and, in doing so, examine the tip portion of new smoke rockets that had been transported from Phonsavan. He said that most appeared "loose" in the portion where the tip and canister joined, whereas the tip and canister of the ordinary explosive-type rockets at Long Tieng were noticeably more tightly connected.

In late 1976, during preparation for airstrikes on Kasy (Louangphrabang Province) and in new areas of Phou Bia, the pilot said he began carrying two or three Vietnamese Army staff officers, sometimes accompanied by a Lao staff officer, in T–41 aircraft for reconnaissance over the target areas. When these airstrikes were launched, the defector pilot initially flew his L–19 aircraft on missions with another pilot and a Lao staff officer. After 2 or 3 weeks, however, Vietnamese staff officers, who spoke excellent Lao, began alternating with the Lao officers. Before each mission, the Vietnamese or Lao staff officer would go over target areas outlined on situation maps—which then were taken along—and would point out the targets to be attacked. The defector pilot noted that at no time did the Vietnamese staff officer communicate with Lao officers on the ground, as did the Lao staff officers. A new Vietnamese officer was assigned for each airstrike mission in the H'Mong areas.

The pilot related that before flying L–19 airstrike missions with a full load of rockets he was often warned by a Lao commander to fly at above-normal altitudes when firing rockets—to preclude hazard to the occupants of the aircraft. For this reason the pilot surmised that the "smoke" rockets fired at the H'Mong were unusual. He was able to observe that the "smoke" rockets detonated in the air and that some produced white smoke, with a mixture of blue, while others produced red smoke, with a mixture of yellow. The ordinary explosive-type rockets detonated on impact. The

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commander or his designated representative told the pilot before every mission that the operations—called Extinct Destruction Operations—were intended to "wipe out the reactionary H'Mong people."

Before a mission involving "smoke rockets," the commander warned the pilots to keep the operation secret. The Lao defector said that, during the nearly 2 years in which he flew rocket missions, he learned from the Lao staff officers accompanying him that there were two types of rockets. The first, mostly "smoke" rockets, were to be fired at targets far away from Lao and Vietnamese troops to avoid exposing them to the poison smoke. The second was of the ordinary explosive type, considered a "close support" rocket that could be fired near Lao troop positions. Initially, the L–19 aircraft carried eight rockets—five "close support" and three "smoke" rockets. Later, only four rockets, mainly of the "smoke" type, were carried.

After each mission in which chemical warfare rockets were used, the pilot was returned to a "rest house" at Phonsavan, where a Lao Army doctor and nurse would examine him. He said that after his missions, especially in 1978, he was particularly well treated by the examining doctor and watched very closely by the nurse. Those L–19 aircraft pilots assigned to missions utilizing chemical warfare rockets had special privileges, including additional flight pay and free meals at the Phonsavan cafeteria. In October 1978, the Lao Army stopped using L–19 aircraft on combat missions and began using Soviet MiG–21s for chemical attacks on the Phou Bia areas.

Several H'Mong reports corroborate the testimony of the Lao pilot. A village chief, for example, described attacks covering all 7 days of the week of June 5, 1976 in the Bouamlong area. He described L–19 aircraft firing rockets that produced red and green smoke: Ten villagers were killed by gas and 30 by shrapnel. Most of the H'Mong reports documented by a U.S. Foreign Service officer in June 1979 and a Department of Defense medical team in October 1979 were consistent with the pilot's testimony. H'Mong observers familiar with military aircraft reported L–19s in use until late 1978. After that time, reports described jets or "MiGs" and some accurately described Soviet AN–2s.

A review of information back to 1975 shows L–19 and T–28 aircraft were operating from airfields in northern Laos—including the one at Phonsavan, where AN–2s were seen in 1978. Failure to observe chemical decontamination equipment at the airfields does not rule out the presence or handling of chemical munitions. The Soviets supervise the chemical warfare activities in Laos; it is assumed that chemical munitions are handled in about the same manner as in the U.S.S.R. According to former Soviet chemical warfare personnel, no protective clothing or special decontamination equipment is required for loading chemical bombs onto aircraft and helicopters at chemical munitions test ranges.

The Lao pilot's description of the rockets used on the L–19 was corroborated by other sources. A H'Mong refugee, a former commander of a 500-man resistance force, reported that in 1977 he found a rocket canister and a separated warhead that he believed were the kinds used by the Vietnamese and Lao. The canister had authentic U.S. markings identifying it as a U.S.-manufactured 2.75-inch rocket and, reportedly, three lines of Russian writing which he could not translate. Another H'Mong resistance force officer, reportedly trained as a liaison officer and ordnance expert before the Communist takeover of Laos, stated that he, too, believed that the rocket canister was of U.S. manufacture and that the Soviet technicians in Laos had modified the upper stage to contain a poisonous (i.e., lethal) chemical.

The diameter of the warhead was reported to be 12.5 centimeters (5 inches), probably a measurement taken on a modified warhead, because the United States does not have a 5-inch warhead for the 2.75-inch "rocket motor." During the Vietnam conflict, about 35 million U.S.-manufactured, conventional 2.75-inch rockets were sent to the war zone, and many tens of thousands of these fell into North Vietnamese hands when the South Vietnamese forces collapsed. The Vietnamese may be using some of these rockets with existing loads, but modified warheads for the 2.75-inch rocket motor could easily be fabricated in Vietnam and filled with a lethal or nonlethal agent in Laos, especially with Soviet assistance. According to U.S. experts, fabrication of a warhead 5 inches in diameter, necked down to fit the 2.75-inch rocket, could be accomplished by trained technicians in a small, well-equipped machine shop and laboratory.

ANNEX B

Findings of U.S. Government Investigative Teams: Use of Chemical Agents Against the H'Mong in Laos

State Department Team

In May 1979, State Department officials visited Thailand to interview H'Mong refugees and investigate allegations of the use of chemical agents against H'Mong tribesmen in Laos (see Table B–1). From the signs/symptoms described and observed, it is suggested that at least two and possibly three different chemical agents may have been used, such as:

- A nerve agent (five or six individuals reported symptoms that could be attributed to a nerve agent);
- An irritant or riot-control agent (one-third of the interviews); and
- More than half of the interviews indicated such a variety of signs and symptoms that it is difficult to attribute them to a single known agent.

It is possible that in some cases two or more agents were combined.

- Reported signs and symptoms suggesting a nerve agent include sweating, tearing, excessive salivation, difficulty in breathing, shortness of breath, nausea and vomiting, dizziness, weakness, convulsions, and death occurring shortly after exposure.
- Reported signs and symptoms suggesting a riot-control or irritant agent include marked irritation or burning of the eyes, with tearing and pain; irritation and burning of the nose and throat; coughing; burning and tightness in the chest; headache; and nausea and vomiting in a few cases.
- Reported signs and symptoms not related to any known single agent include a mixture of the above as well as profuse bleeding from mucous membranes of the nose, lungs, and gastrointestinal tract, with rapid death of the affected individuals in some instances.

Estimates from the H'Mong interviewed indicate that approximately 700–1,000 persons may have died as a result of the use of chemical agents and that many times this number became ill. It was reported that on many occasions entire villages were devastated by these agents, leaving no survivors.

In the episodes described, most of the animals exposed to the chemical agents were killed. Generally, all

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chickens, dogs, and pigs died and, to a lesser extent, the cattle and buffalo. On several occasions it was reported that where these agents settled on tree and plant leaves, many small holes appeared in the leaves within 2 or 3 days. Rarely did agent exposure result in the defoliation or death of the plants.

Department of Defense Team

From September 28 to October 12, 1979, a team from the U.S. Army Surgeon General's Office was in Thailand to conduct a similar series of interviews.* The team visited the following H'Mong refugee camps of northern Thailand: the detention center at Nong Kai, the large H'Mong camp at Ban Vinai, and two smaller camps at Nam Yao and Mae Charim. As the great majority of refugees as well as the H'Mong leadership are at Ban Vinai, most interviews were obtained there.

The team was prepared to obtain blood and skin samples (for cholinesterase activity and study of pathological changes, respectively) from those exposed to chemical agents. For such samples to yield meaningful results they must be taken within 6–8 weeks of exposure. Since the last reported exposure was in May 1979, no blood or skin samples were collected.

Interviews were conducted through interpreters; one was an employee of the U.S. Consulate at Udorn, and the remainder were hired from among the refugees. The interpreters screened those refugees who volunteered to talk to the team and selected only those who had been eyewitnesses to or had themselves been exposed to an agent attack. Team members interviewed 40 men, 2 women, and a 12-year-old girl. Each interview took 1–2 hours. To insure conformity, a prepared questionnaire was used as a guide.

The chemical attacks reportedly occurred between June 1976 and May 1979 (Table B-1). The absence of reports of attacks after May 1979 may be because

TABLE B-1

Reports of Probable Chemical Agent Attacks in Laos

Department of State Interviews Conducted in Summer 1979

Date	Location	Method of Attack by Plane	Material Used (Smoke/Gas)
Oct. 1977	Phu Hay, S. of Phou Bia	Rockets	Yellow-gray
1978	Pa Sieng, S. of Phou Bia	Bomb	Yellow
Feb. 1978	Ban Nam Luk, S. of Phou Bia	Spray (?)	Yellow/white
Feb. 1978	20 kms SE. of Phou Bia	Spray (?)	Yellow
Feb. 1978	Ban Ko Mai	Bomb	Yellow
Mar. 1978	Pha Houei	Sacks, burst in air	Brown
Mar. 1978	Ban Na Pong	(?)	Yellow
Apr. 1978	Ban Phamsi	(?)	White, green, blood-colored
May-Apr. 1978	Ban Nong Po	Cloud	Yellow-brown like rain
June 1978	Ban Nam Teng	Rocket (?)	Yellow
June 1978–May 1979	Ban Don area	Spray	Yellow
Mid-1978	1–3 kms NE. of Phou Bia	Rocket, air burst	Red
Oct. 1978	Nam Kham	Rockets, air burst	Yellow
Oct. 1978	6 kms N. of Phou Khao	Rockets, air burst	Red
Oct. 1978	3–4 kms N. of Phou Bia	Rockets, air burst	Yellow-gray
Nov. 1978	Phou Xang Noi	Spray	Yellow, blue
Nov. 1978	near Phou Bia	Bomb, air burst	Yellow
Nov. 1978	NE. of Pha Khao	Rocket, air burst	Yellow
Apr. 1979	Ban Nouia Pong	Spray	Yellow
May 1979	Nam Po	Spray	Yellow
May 1979	Pha Mai	Spray, air burst	Yellow

Department of Defense Interviews Conducted in Fall 1979

Date	Location	Method of Attack by Plane	Material Used (Smoke/Gas)
June 1976	Pou Mat Sao	Rockets	Red, green
Jan. 1977–Oct. 1978	Pha Khao	Rockets	Yellow, red, green
Mar. 1977	Nam Theuna	Rockets	Red, yellow
Apr. 1977	Houi Kam Lang	Rockets	Yellow
May 1977	Pha Khae	Rockets	Red
May 1977	Nam Moh	Rockets	Yellow
May 1977	Pha Ngune	Spray/rockets	Yellow
1977–1978 (3 attacks)	Phu Seu	Rockets	Red, green, yellow
Jan. 1978	Houi Xang	Rockets	Red, green
Feb. 1978	Sane Mak Ku	Rockets	Yellow
Feb. 1978	Tham Se Sam Leim	Rockets	Yellow, black
Feb. 1978	Kio Ma Nang	Rockets	Yellow
Mar. 1978	Mouong Ao	Rockets	White
Mar. 1978	Khieu Manang	Rockets	Green
Apr. 1978	Tha Se	Rockets	White
June 1978	Pha Phay	Rockets	Yellow
June 1978	Phou Seng	Rockets	Red, white, black
July 1978	Phou Bia	Rockets	Red
July 1978	Ban Nam Mo	Spray	Yellow
July 1978	Phou Lap	Rockets	Yellow
Aug. 1978	Pha Houai	Rockets	Red, green
Aug. 1978	Ban Thin On	Rockets	Green, red
Aug. 1978	Bouamlong	Rockets	Red, green, yellow
Sept. 1978	Pha Koug	Rockets	Yellow
Sept. 1978	Ban Nam Tia	Spray/rockets	Yellow, green, red
Sept. 1978	Pha Na Khum	Rockets	Red
Oct. 1978	Phou Bia	Rockets	
Oct. 1978	Ban Done	Spray	Yellow
Oct. 1978	Phou Bia	Rockets	White, green, red
Nov. 1978	Phou Bia	Rockets	White, red
Feb. 1979	Pha Mat	Spray	Yellow
Feb. 1979	Tong Moei	Rockets	Yellow, red
Mar. 1979	Pha Mai	Spray	Yellow
Mar.–May 1979 (6 attacks)	Pha Mai	Spray	Yellow
Apr.–May 1979 (4 attacks)	Pha Mai	Spray	Gray-white
May 1979	Phou Bia	Spray	Yellow
May 1979	Moung Phong	Rockets	Red

* The authors of the U.S. Army Surgeon General's report are Charles W. Lewis, M.D., COL, MC, Chief, Dermatology Service, Brooke Army Medical Center, Fort Sam Houston, Texas; Frederick R. Sidell, K.D., Chief, Clinical Resources Group, U.S. Army Biomedical Laboratory, Aberdeen Proving Ground, Md.; William D. Tigertt, M.D. (Brigadier General, Ret., USA), Professor of Pathology, University of Maryland, Baltimore, Md.; Charles D. Lane, LTC, Southeast Asia Desk Officer, OACSI, Department of the Army, Washington, D.C.; and Burton L. Kelley, SP5, USA, Dermatology Technician, Brooke Army Medical Center, Fort Sam Houston, Texas.

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few refugees crossed the Mekong River after that time—as a result of heavy rains and flooding from June to September 1979. Most of the early reports were of the use of rockets releasing the agent; beginning in the fall of 1978, the majority of the attacks were carried out by aircraft spraying a yellowish substance which "fell like rain." The attack sites, concentrated around the H'Mong stronghold in the mountainous Phou Bia area, also are listed in Table B-1.

The team was given a plastic vial containing pieces of bark, stained by a yellow substance, which several H'Mong refugees claimed was residue from an aircraft spray attack in April 1979. Preliminary chemical analysis of the sample indicates that no standard chemical agent (i.e., an agent listed in TH 8-285, U.S. Army, May 1974) was present.

Conclusions

The conclusions of these teams, based upon interviews obtained from H'Mong refugees, are as follows:

- Chemical agents have been used against the H'Mong.
- The reported effects of these agents suggest the use of a nerve agent, a riot-control agent, and an unidentified combination or compound.

ANNEX C

Medical Evidence

Southeast Asia

Since 1975, many different sources—refugees, relief workers and medical personnel, including specially qualified physicians—consistently have detailed unusual signs and symptoms of victims of "yellow rain." Specifically, victims in Southeast Asia subjected to a direct attack of the yellow powder, mist, smoke, or dust would be seen to begin retching and vomiting within minutes. These effects and those described below were not pronounced in individuals even 100 meters from the attack zone, indicating a relatively dense chemical/carrier combination that was effective in low wind conditions.

Following the victim's exposure to yellow rain, the initial induced vomiting—unlike that caused by a traditional riot-control nausea agent—was protracted over hours to days. It was often accompanied by dizziness, rapid heartbeat and apparently low blood pressure, chest pain, loss of far-field vision, and a feeling of intense heat and burning on the skin, although not described as being most acute in the groin and axillae. Thus, the acute signs and symptoms match some effects of traditional vomiting and blister agents but clearly not all.

Within the first hours after the attack, many victims also reported intense red eyes, bleeding gums, convulsions or more often trembling, and vomiting of blood, with or without production of copious amounts of saliva—lasting many hours to days, apparently depending on the exposure level. Thick mucous, pinpoint pupils, respiratory collapse, prolonged spasticity, and involuntary urination or defecation were never reported after a yellow rain attack; the absence of these symptoms helped to rule out organophosphate nerve agents in the minds of chemical warfare experts. Many medical and environmental samples also ruled out these and other traditional agents such as DM, DS, and others.

Many observers of "yellow rain" effects reported formation within several hours of small (1 centimeter) homogeneous, hard, fluid-filled blisters over only exposed areas of skin, frequently including the victim's hands, arms, entire throat, and face—wherever skin was uncovered. In most cases the vomit, after 2-8 hours, contained blood and, in many cases, large amounts of it. About half of those receiving the most concentrated doses of yellow material—those who had been directly under the spray—were observed within several hours to cease vomiting temporarily. This interval was often followed in 5-15 minutes by a period of great pain when the victim would hold his abdomen and emit a gush of blood from mouth and nose. These individuals usually died within minutes afterward.

Close questioning by physicians of witnesses to these final moments leaves no doubt that the effects resulted from severe gastrointestinal bleeding, significant pulmonary bleeding, temporary compression of accumulated blood in the stomach, and, finally, projectile vomiting of as many as several hundred milliliters of blood. These findings were consistent with animal and human autopsies.

Many victims of the yellow material received less than the full brunt of a spray, entered the attack zone several hours to 2 days later, or consumed food or water contaminated by the material. These individuals—often within the next 24 hours—developed signs and symptoms similar to those more directly affected but often without pronounced skin effects if they had not contacted the powder residue directly. In addition to attacks of intense vomiting five or six times a day, they also had diarrhea, with bloody stools passed up to eight times a day. Bleeding under the fingernails and around the skin of the eyes and severe bruising of the skin also were commonly reported. Opiates helped the fluid loss in adults, but in children or young persons unable to tolerate the treatments of raw opium and water, death occurred after 10 days to 2 weeks in about half the cases. On the basis of reported signs and symptoms, the cause of delayed death almost certainly was dehydration.

In many cases, chemical attacks are reported to produce symptoms other than those described here. However, there has always been a direct association of the above symptoms with reports of yellow rain attacks—that is, when yellow material is used these symptoms appear; other agents may give rise to other symptoms. Although it is possible to exhibit one or even several of these symptoms associated with traditional chemical warfare agents, no expert has been able to fit the sequence, severity, and consistency with any of them. In many cases, victims and observers were examined, histories taken, and interviews conducted by several health professionals weeks apart. Remarkable consistency has been observed.

From the beginning of the yellow rain episodes in 1975, autopsies occasionally have been reported anecdotally. Some have been done inexpertly, some by nonphysicians, and some were performed on animals rather than on human victims. However, the consistency of the early reported "putrefaction" or "rottenness" of the digestive tract within 12-48 hours after death led many forensic medical experts to suspect that one effect of the poison—whatever it was— was to cause necrosis (cell death) of rapidly dividing mucosa (mucous membranes), especially in the stomach and upper small intestine. Other autopsy findings included hyperemia (engorgement with blood) of digestive mucosal linings and remarkably intense congestion and swelling in the lungs, liver, spleen, and sometimes the kidneys. These and other findings often led experts in toxicology and pathology, on the basis of clinical and pathological data alone, to suggest mycotoxin or even trichothecene intoxication.

Trichothecene effects have been reported in the forensic, oncological, and toxicological literature for several years. Unpublished findings often have been discussed in symposiums. In several dozen cases, toxic effects in humans and

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animals have been carefully recorded, and they match those of yellow rain with good precision (see Table C-1). *There are no additional signs or effects of known trichothecene intoxication not frequently reported by victims, nor are there any reported yellow rain symptoms that cannot be explained by the effects of the four specific trichothecene toxins found in the samples.*

There are no significant medical differences in the reporting from Laos and Kampuchea. Although the timing and delivery systems have sometimes varied, the effects of the chemical agent, clinically and pathologically, are identical. In some cases, a series of blood samples from Kampuchean victims also showed a trend toward leukopenia (reduction in the number of white blood cells) and the presence of a trichothecene metabolite (HT-2) consistent with trichothecene intoxication (see Annex D). Dose-response effects that were observed and routes of administration were both consistent with effects of trichothecenes.

An early hypothesis (1978–79) was that a significant number of deaths, especially in Laos, could be explained by the heavy use of riot-control agents such as CS, CN, DM, and agents which cause itching and/or blistering. This hypothesis was rejected quickly on two grounds. First, trace contaminant analysis failed to show the presence of any of these compounds in samples; several samples did, however, contain a trichothecene precursor. Second, contrary to commonly held views, the epidemiology of diseases endemic to the central highlands of Laos and the public health situation of the H'Mong do not support the view of malnourished, disease-ridden, and weak persons who would succumb easily to riot-control agents. Also, many studies have shown the opposite: a relatively low incidence of pulmonary disease, lower than what could otherwise account for certain effects; better nutritional states than could otherwise account for death in 10 days to 2 weeks from water loss (dehydration) and calorie depletion; and a death rate of nearly zero from causes other than infection, old age, and trauma.

TABLE C-1

Comparison of Reported "Yellow Rain" Effects With Known Trichothecene Effects

Yellow Rain Reports*	Effects of Trichothecenes
1. Nausea, vomiting—severe, immediate	1. Nausea, vomiting—severe, immediate
2. "Falling down, world turning"	2. Dizziness
3. "Burning of skin"—small blisters	3. Generalized erythema with a burning sensation of skin
4. "Shaking all over, flopping like fish out of water"	4. Ataxia (failure of muscular coordination), occasional tremors and convulsions
5. "Bleeding eyes"	5. Congestion of the sclera (white outer coat of eyeball) and blood in tears
6. "Pounding" chest, rapid heartbeat, weakness	6. Hypotension (abnormally low blood pressure) with secondary rise in heart rate
7. Severe pain in center of chest	7. Angina (substernal chest pain)
8. Sleepiness, "not able to talk"	8. Somnolence, central nervous system symptoms
9. Bleeding gums and profuse salivation	9. Stomatitis (inflammation of oral mucous membranes) and ptyalism (excessive salivation)
10. "Can't breathe"	10. Shortness of breath
11. "Skin and body hot with cold"	11. Fever and chills
12. Diarrhea with blood	12. Diarrhea with blood
13. Loss of appetite, inability to eat	13. Anorexia
14. Bleeding into skin and fingernails	14. Thrombocytopenia (decrease in number of platelets, white blood cells involved in clotting of blood) and purpura (skin discoloration caused by hemorrhage into tissues)
15. Drop in white blood cell count	15. Leukopenia and anemia
16. "Rotten esophagus, stomach, intestines; soft spleen and liver"	16. Rapid necrosis of linings of gastrointestinal tract; lymphoid necrosis in spleen and liver
17. Swelling of all organs	17. Congestion of all organs

* Effects are immediate at levels near to or above a rough estimate of 500–1,000 mg total body burden for an adult. Although inhalation data are pending, the levels are consistent with reported lethal and sublethal doses. Trichothecenes in combination, when directly ingested or inhaled, or in purified form, are more toxic in lower concentrations, and the order of signs and symptoms and timing varies.

Afghanistan

Some deaths associated with bleeding have been described in the accounts from Afghanistan. In one set of cases, a physician examined persons who had been exposed to sublethal doses of a yellow smoke/black smoke combination attack and one man near death after a series of attacks. Hemoptysis (nasal bleeding)—but not hematemesis (bleeding from the gastrointestinal tract)—was reported in about half of these cases.

Several features of at least one of the chemical agents—an incapacitant—used in Afghanistan defy explanation at this time. One possibility is that the agent(s) are highly selective for the central nervous system rather than the autonomic nervous system. As yet, no good candidate agent has been identified which will selectively inhibit the central nervous system so as to cause unconciousness for several hours. Another finding has been the presence of a dermal anaesthesia, affecting only exposed areas of skin.

Postattack Medical Survey

There is evidence that after some attacks in Laos and Afghanistan, Lao Communist or Soviet forces entered the attack zones to conduct surveys. Several reports indicate that survivors from a toxin attack on a Lao village were taken several kilometers from the village and injected with a small volume of a clear solution said by their captors to be a "new" medicine to assess the gas. The injections, given intramuscularly in the upper arm, reportedly did nothing to

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alleviate the weakness, nausea, vomiting, or diarrhea suffered by the survivors. One victim reported the drug caused an immediate sensation of warmth throughout his body. Only the use of opium later eased the discomfort. It is probable that this procedure was a test either of a new antidote or of a drug developed to reduce incapacitation from the nausea and vomiting.

Similarly, in a few cases in Afghanistan, Soviet troops reportedly disembarked from helicopters or armored personnel carriers at the edge of an attack site. Three or four, dressed in full anticontamination gear, walked among the dead, examined the corpses and, opening them with a crude incision, examined the organs in the abdominal and thoracic cavities. In one case, a solution was poured into the incision. When the corpses were later recovered by the *mujahidin,* the body cavity contents had been destroyed beyond recognition. These and a few additional reports support the hypothesis that the perpetrators of some of the attacks were interested in studying aftereffects, lethality, or some other quasi-experimental aspect of the use of a new chemical weapon. Recent indications from Afghanistan indicate that one purpose of the field surveys and body examinations is to determine levels of toxic materials still present in the attack zone before Soviet troops occupy it.

ANNEX D

Analysis and Review of Trichothecene Toxins

Sample Analyses for Trichothecenes

The Trichothecene Hypothesis. Since 1975, the U.S. Government has received remarkably consistent reports detailing chemical attacks in Southeast Asia. Some of these reports described the use of lethal agents which produced symptoms that could not be correlated with those produced by known or traditionally recognized chemical warfare agents or combinations of them (see Table D–1). It is readily apparent that the symptoms most frequently described in Laos and Kampuchea correspond most closely with those produced by a group of mycotoxins—the trichothecenes. A review of the scientific literature revealed not only that these compounds had physical and chemical properties indicating potential as chemical agents but also that they were the subject of intensive investigation by Soviet scientists at institutes previously linked with chemical and biological warfare research. In the fall of 1980, the trichothecenes were added to the list of agents suspected to have been used in Southeast Asia and Afghanistan. Other candidates under consideration included phosgene oxime, arsines, cyanogen chloride, nerve agents, riot-control agents, and combinations of these agents.

Many samples from chemical attacks in Laos and Kampuchea were examined at the U.S. Army's Chemical Systems Laboratory (CSL) for the presence of traditional chemical warfare agents and were reported to be negative. In March 1981, CSL reported the presence of an unusual compound ($C_{15}H_{24}$) in the vapor analyses from several clothing and tissue samples taken from the victim of a chemical attack. The compound was closely related in structure to the simple trichothecenes. This finding sparked the request for analysis of all future samples for the presence of trichothecene mycotoxins.

The Kampuchean Leaf and Stem Sample: The First Analysis for Trichothecenes. On March 24, 1981, a number of samples were received from the U.S. Embassy in Bangkok. Two were reported to have been collected from the site of a chemical attack that occurred in the vicinity of TV 3391, an area just south of Phnom Mak Hoeun. A vegetation sample and a water sample were collected within 24 hours of the attack. Examination of bodies of victims of this attack by medical personnel revealed highly unusual degeneration of the mucosal lining of the gastrointestinal tract. The effects described paralleled those known to be produced by the trichothecenes. The samples were submitted to the Chemical Systems Laboratory for analysis for the presence of chemical warfare agents. With the exception of the unusual presence of high levels of CN-, Cl-, and F-ions, no evidence of known chemical warfare agents was found. An initial test for the trichothecenes by thin layer chromatography was inconclusive because of severe problems with interfering substances and the lack of appropriate standards.

The trichothecenes are difficult to detect even under ideal circumstances, and the presence of interfering substances in the sample may make identification and quantification by thin layer chromatography inconclusive. A review of the limitations and potentials of the analytical methods for trichothecenes led to the conclusion that the computerized gas chromatography/mass spectroscopy method in the selected ion-monitoring mode enabled precise identification and quantification of these compounds in complex mixtures. A comparison of the currently available methods suitable for trichothecene analysis and an assessment of their utility and limitations is presented in Table E–3.

A portion of the leaf and stem sample was furnished to the U.S. Army Medical Intelligence and Information Agency for further analysis. This sample, a positive control sample to which T–2 toxin was added, and a negative control sample of similar vegetation were forwarded to Dr. Chester J. Mirocha of the Department of Plant Pathology, University of Minnesota. Dr. Mirocha was given no information concerning the history or content of the samples and was requested to analyze the three unknowns for the presence of trichothecene toxins using the best methods at his disposal.

The analysis involves a series of extractions followed by ferric gel separation, selected ion monitoring on a computerized gas chromatograph/mass spectrometer, and a full mass spectral scan for comparison with known standards. The methods used are among the most sensitive and specific for detection of these compounds; also, false positives are rare. Toxins can be identified by their mass spectra and quantified with a high degree of accuracy. The vegetation sample allegedly exposed to a chemical warfare agent was found to contain 109 parts per million (ppm) of nivalenol, 59.1 ppm of deoxynivalenol, and 3.15 ppm of T–2 toxin; each is a potent toxin of the trichothecene group. No trichothecenes were detected in the negative control sample, and 35 ppm of T–2 toxin were detected in the sample to which T–2 toxin had been added. It was Dr. Mirocha's assessment that a mixture of these particular toxins in the high levels detected could not have occurred as a result of natural contamination.

The possibility that the identified toxins were produced by natural fungal contamination was discounted on the basis of the climatic conditions required for production of T–2 toxin, the high levels of toxins detected, the unusual mixture of toxins found, and the results of surveys of Southeast Asia for the presence of these toxins. This conclusion was supported by the analysis of normal flora samples from Kampuchea described below.

Analyses of Control Samples From Kampuchea for the Presence of Trichothecenes. On September 20, 1981, the U.S. Army Medical Intelligence and Information Agency received nine control samples from U.S. Army personnel in Bangkok for the purpose of conducting laboratory analyses for background

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TABLE D-1

Symptoms of Chemical Attacks Reported in Laos, Kumpuchea, and Afghanistan

Symptom	% of Reports Mentioning Symptom	Tricho-thecenes	Nerve Agents	Arsines	Phosgene Oxime	Cyanogens	Incapacitant (BZ)	Riot-Control Agents
Laos								
Multiple deaths	84.6	X	X	X	—	X	—	—
Vomiting	71.4	X	X	X	—	—	—	X
Diarrhea	53.1	X	X	X	—	—	—	—
Hemorrhage	52.0	X	—	—	X[a]	—	—	—
Breathing difficulty	47.95	X	X	X	X	X	X	X
Itching and skin irritation	43.9	X	—	X	X	—	—	X
Nausea	42.8	X	X	X	—	—	X	X
Animal death	41.8	X	X	X	—	X	—	—
Blurred vision	39.7	X	X	X	X	X	X	X
Headache	36.7	X	X	—	X	—	X	X
Fatigue	35.7	X	X	—	—	—	X	—
Nasal excretion	34.7	X	X	X	X	—	—	X
Rash or blisters	32.6	X	—	X	X	—	—	X
Tearing	30.6	X	X	X	X	X	—	X
Coughing	28.6	X	X	X	X	X	—	X
Effect on vegetation	26.5	X	—	X	X	—	—	—
Dizziness and vertigo	25.5	X	X	—	—	X	X	X
Facial edema	20.4	X	—	X	X	—	—	X
Thirst and dry mouth	20.4	X	—	—	—	—	X	—
Skin color change	16.3	X	—	—	X	—	—	—
Tachycardia	12.3	X	X	—	X	X	X	X
Temporary blindness	9.18	X	—	X	X	—	X	X
Rapid loss of consciousness	9.18	X[b]	X	—	—	X	X	—
Salivation	6.12	X[c]	X	—	—	—	—	—
Hearing loss	5.1	X	—	—	—	—	—	—
Tremors or convulsions	4	X	X	—	X	X	—	—
Sweating	3	—	X	—	—	—	—	—
Paralysis	3	X	X	—	—	X	—	—
Loss of appetite	3	X	X	X	—	—	—	—
Frequent urination	2	X	X	—	—	—	—	—

Continued on p. 25

Note: This table is a compilation relating the signs and symptoms reported in the three countries to symptoms associated with certain chemical agents. The frequency with which a particular symptom was reported is expressed as a percentage of the total number of attacks.

levels of trichothecene toxins. The samples were collected from an area near TV 3391 that had not been subjected to any reported chemical attacks. The samples were collected by U.S. personnel under instructions to reproduce the sampling conditions, handling, packaging, and transfer conditions of the original sample as closely as possible. The same species of plant was sampled, and four other vegetation samples also were collected. A water sample and two soil samples were recovered. Corn and rice samples from the area also were taken. These grains provided an ideal substrate for growth of toxin-producing fungi and would, therefore, be a sensitive indicator of any natural occurrence. The nine samples were forwarded under code to Dr. Mirocha for trichothecene analysis. A portion of each sample also was submitted to Chemical Systems Laboratory for background determinations of CN-, Cl-, and F-levels. No trichothecenes were detected in any of these samples, indicating that nivalenol, deoxynivalenol, T-2, and diacetoxyscirpenol are not prevalent in the geographical area from which the alleged chemical warfare-exposed sample was collected. The appearance of these trichothecenes in high levels and unique combinations in a sample associated with a chemical attack—which produced symptoms typical of trichothecene exposure—indicates that these toxins may have been used as chemical weapons. This conclusion is further supported by the evidence provided by analysis of additional alleged chemical warfare samples from Laos and Kampuchea as described below.

Analysis of Additional Chemical Warfare Samples From Laos and Kampuchea for the Presence of Trichothecenes. The U.S. Army Medical Intelligence and Information Agency received from the Chemical Systems Laboratory three additional suspected chemical warfare samples for analysis for trichothecenes. The first sample consisted of 10 ml of water taken from the same chemi-

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TABLE D-1 (continued)

Symptoms of Chemical Attacks Reported in Laos, Kumpuchea, and Afghanistan

Symptom	% of Reports Mentioning Symptom	Tricho-thecenes	Nerve Agents	Arsines	Phosgene Oxime	Cyanogens	Incapacitant (BZ)	Riot-Control Agents
Kampuchea								
Multiple deaths	72.4	X	X	X	—	X	—	—
Hemorrhage	62.06	X	—	—	X[d]	—	—	—
Dizziness and vertigo	51.7	X	X	—	—	X	X	X
Vomiting	41.3	X	X	X	—	—	—	X
Nausea	34.5	X	X	X	—	—	X	X
Skin irritation	27.6	X	—	X	X	—	—	X
Rapid loss of consciousness	24.1	X[b]	X	—	—	X	X	—
Fever	20.68	X	—	—	—	—	—	—
Headache	17.2	X	X	—	X	—	X	X
Tearing	13.8	X	X	X	X	X	X	X
Breathing difficulty	13.8	X	X	X	X	X	X	X
Fatigue	13.8	X	X	—	—	—	X	—
Paralysis	10.3	X	X	—	—	X	—	—
Numbness	6.9	X	X	—	—	X	X	—
Blurred vision	6.9	X	X	X	X	X	X	X
Dry throat and thirst	6.9	X	—	—	—	—	X	—
Edema	6.9	X	—	X	X	—	—	—
Salivation	3.4	X[c]	X	—	—	—	—	—
Vegetation affected	3.4	X	—	X	—	—	—	—
Diarrhea	3.4	X	X	X	—	—	—	—
Cough	3.4	X	—	X	X	X	X	X
Nasal discharge	3.4	X	X	X	X	—	—	X
Rash or blister	3.4	X	—	X	X	—	—	X
Chills	3.4	X	?	—	—	—	—	—
Hearing loss	3.4	X	—	—	—	—	—	—
Afghanistan								
Rapid loss of consciousness	47.9	X[b]	X	—	—	X	X	—
Skin irritation and itching	31.5	X	—	X	X	—	—	X
Multiple deaths	30.1	X	X	X	—	X	—	—
Nausea	20.5	X	X	X	—	—	X	X
Vomiting	19.1	X	X	X	—	—	—	X
Tearing	17.8	X	X	X	X	X	—	X
Dizziness and vertigo	16.4	X	X	—	—	X	X	X
Blisters or rash	15	X	—	X	X	—	—	X
Difficulty breathing	13.7	X	X	X	X	X	X	X
Paralysis	13.7	X	X	—	—	X	—	—
Headache	12.3	X	X	—	X	—	X	X
Temporary blindness	8.2	X	—	X	X	—	X	X
Salivation	6.8	X[c]	X	—	—	—	—	—
Loss of appetite	6.8	X	X	X	—	—	—	—
Effects on vegetation	5.5	X	—	—	—	—	—	—
Fatigue	5	X	X	—	—	—	X	—
Confusion	4.1	X	X	—	—	—	X	—
Hemorrhage	4.1	X	—	—	X[a]	—	—	—
Change in skin color	2.8	X	—	—	X	—	—	—
Diarrhea	2.8	X	X	X	—	—	—	—
Coughing	1.3	X	X	X	X	X	X	X

[a] Bloody frothing.
[b] Only at very high doses.
[c] Depending on which trichothecenes.
[d] Blood flecked frothing.

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cal attack site in Kampuchea as the leaf and stem sample previously examined. The second sample came from the site of a "yellow rain" attack occurring on March 13, 1981, in the village of Muong Cha (TF 9797) in the Phou Bia region of Laos. The agent was sprayed from a twin-engine propellor aircraft at about noon, local time. The falling substance was described as "like insect spray" and sounded like drizzling rain. Quite sticky at first, it soon dried to a powder. Symptoms described by victims included nausea, vomiting, and diarrhea. A sample of the agent scraped from the surface of a rock by a victim and carried into Thailand was turned over to U.S. Embassy personnel. The third sample was taken from the site of a "yellow rain" attack that occurred at 2:00 p.m. on April 2, 1981, at Ban Thong Hak (TF 9177). Twenty-four people reportedly died in this attack; there were 47 survivors. Symptoms included severe skin irritation and rash, nausea, vomiting, and bloody diarrhea. A survivor of the attack scraped this sample from the surface of a rock with a bamboo knife. Although the individual took precautions (that is, cloth mask), a severe skin rash and blisters developed.

These three samples were submitted to Dr. Mirocha for analysis. The water sample from Kampuchea contained 66 ppm of deoxynivalenol and a trace amount of diacetoxyscirpenol. A trace quantity of the second sample was screened as strong positive for trichothecenes. Further analysis of that sample confirmed the presence of high levels of T-2 toxin (150 ppm) and diacetoxyscirpenol (25 ppm). Nivalenol and deoxynivalenol may also be present but are being masked by interference from phtalate compounds (leached from the plastic packaging). An effort to modify the extraction process is being made in order to overcome the interference so that nivalenol and deoxynivalenol can be measured more easily. Interestingly, examination of the petroleum ether fraction from the sample revealed the presence of a yellow pigment almost identical to that previously identified by Dr. Mirocha in cultures of *Fusarium roseum,* indicating that the yellow powder probably consisted of the crude extract of a *Fusarium* culture.

There was little of the third sample contained in the vial received for testing. The quantity was too small to be weighed accurately, and inspection of the vial revealed only a small speck estimated to weigh much less than 0.1 mg. That speck contained 10 ng of diacetoxyscirpenol, a level equivalent to 100 ppm at the very least and probably much higher. The sample size was too small to allow adequate analysis for the other three trichothecenes of interest.

These results support the hypothesis that trichothecenes have been used as chemical warfare agents in Laos and Kampuchea. The presence of these high levels of trichothecene toxins in water and in yellow powder scraped from rocks argues against natural occurrence, since neither water nor rock is a suitable environment for growth of the fungi required to produce the toxins.

Differences between the analyses of the Kampuchean leaf and stem sample and the water sample collected from the same attack site raise additional questions. Failure to find T-2 toxin in the water sample is probably due to the relative insolubility of T-2 toxin in water. The presence of diacetoxyscirpenol in the water might be the result of biotransformation or breakdown of T-2, as they are so structurally similar, differing only in the substitution on carbon 8. While this hypothesis cannot be entirely ruled out, it is unlikely on the basis of known biotransformation of T-2 in the laboratory. The initial vegetation sample was not screened for diacetoxyscirpenol, although the mass spectra from the initial analysis will be reexamined for trace amounts of it.

The absence of nivalenol in the water sample is more difficult to explain because nivalenol is water soluble. The effect of environmental conditions and microorganisms on the stability of these compounds may vary widely for each of the specific compounds and may explain the analytical results. Further scientific investigation of these factors is needed.

Analysis of Blood Samples From Chemical Attack Victims

Blood samples drawn from victims of recent chemical attacks in Kampuchea have been received by the U.S. Army Medical Intelligence and Information Agency for analysis for indications of trichothecene exposure. Little is known concerning the rate of metabolism of trichothecenes in humans; it is difficult, therefore, to estimate the probability of detecting trichothecenes or their metabolites in blood samples. T-2 is rapidly cleared from the blood in animals, and 25% of the total dose is excreted within 24 hours after exposure; it is unlikely that trichothecenes could be detected unless blood samples were obtained within 24-48 hours after an attack. Other blood parameters are affected by the trichothecenes, however, and may prove to be useful markers. The trichothecenes induce a severe leukopenia (decrease in white cell count) which can persist for several weeks following exposure. In addition, the trichothecenes affect some liver and kidney function marker enzymes which can be monitored in the blood.

On October 11, 1981, four whole blood samples and four blood smears were received from the U.S. Embassy in Bangkok. The blood was drawn from four Khmer Rouge soldiers on October 7, 1981 at a Khmer Rouge hospital inside Kampuchea. Detailed medical histories as well as descriptions of the attack were recorded on each individual from whom a blood sample was taken. All four men were victims of a gas attack occurring near Takong on September 19, 1981. Symptoms experienced included vomiting, blurred vision, bloody diarrhea, difficult breathing, dry throat, loss of consciousness, frontal headache, tachycardia, and facial edema. Unfortunately, the samples could not be refrigerated until 48 hours after collection. Thus, it was impossible to obtain data concerning white cell counts and blood chemistry. The four whole blood samples were submitted to Dr. Mirocha for analysis for trichothecene metabolites because of the possibility, admittedly remote, that some of the metabolites might bind to blood proteins and might still be detectable even 3 weeks after an attack.

On October 22, 1981, additional blood samples were received. These had been drawn from nine victims from the September 19 attack and from four control individuals of similar age and background who had not been exposed to a chemical attack. The samples had been properly refrigerated and were accompanied by complete and detailed medical histories taken by trained medical personnel who examined the individuals. Included in the package were blood smears and heparinized and nonheparinized samples from each individual. The samples were submitted for blood assays to the U.S. Army Medical Research Institute of Infectious Diseases.

The above results show no statistically significant differences between exposed and control groups (students T-test). In eight individuals exposed to a chemical agent, a trend toward depressed white cell counts was observed. Such an observation would be compatible with the clinical picture of toxin exposure; however, it is also compatible with a number of other medical problems, and a larger control sample would

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be required before such results could be adequately interpreted. Abnormal liver and kidney functions were not indicated by these data.

Portions of the blood samples were analyzed by Dr. Mirocha for the presence of trichothecenes and/or trichothecene metabolites. The results of the analyses are consistent with trichothecene exposure in at least two of the gassing victims and tend to support the hypothesis that a trichothecene-based agent was used in this attack.

Using the selected ion-monitoring gas chromatography/mass spectroscopy analysis technique, Dr. Mirocha was able to identify tentatively a metabolite of T-2 toxin (that is, HT-2) in the blood of two alleged victims. The compound was identified on the basis of its selected ion masses and gas chromatographic retention times.

The tentative identification of HT-2 in the blood of two victims, and the trend toward depressed white cell counts in these same victims, cannot be taken as conclusive scientific proof of toxin exposure because the trace amount of the compound present precluded unequivocal identification and quantification and because many other medical problems in addition to toxin exposure can cause a decrease in white cell counts. It is interesting to note that the individual who showed the greatest amount of the compound tentatively identified as HT-2 in his blood reportedly received the greatest exposure to the agent. He was exposed to contaminated water for more than 30 minutes and was the only victim who fell down in the water and actually swallowed some of it. However, the description by victims of symptoms correlating exactly with those associated with trichothecene poisoning provides strong circumstantial evidence that trichothecenes were used as chemical agents in yet another chemical attack in Southeast Asia.

Trichothecenes have been identified previously in environmental samples taken from several other chemical attacks in Laos and Kampuchea. Analysis of control vegetation, water, soil, corn, and rice samples from these areas, as well as reviews of published scientific literature, indicates that the particular toxins that have previously been identified are not known to occur naturally in the combinations found and at the levels detected in Southeast Asia. The latest analysis results contribute another piece of evidence to the growing body of data supporting the charge that trichothecenes have been used as chemical/biological agents in Southeast Asia.

ANNEX E

Overview of Natural Occurrence and Significant Properties of Trichothecenes

Historical Trichothecene Mycotoxicoses

The trichothecenes are members of a large group of naturally occurring toxins known as mycotoxins. The word "mycotoxin" is derived from the Greek "mykes" meaning fungus and the Latin "toxicum" meaning poison. It refers to a metabolite produced by a mold that is toxic to man and animals. Mycotoxicoses have been described as the "neglected diseases," and before 1960 English-language literature concerning the diseases caused by mycotoxins was scarce. Soviet scientists have been involved in research with some of these compounds for almost 30 years longer than their Western counterparts. The Soviet Union has had serious problems with mycotoxin contamination of food and has suffered several severe outbreaks of disease in humans. The first comprehensive studies of mycotoxin diseases were conducted in the Soviet Union in the late 1930s.

Since the 1940s, the group of mycotoxins figuring most prominently in Soviet scientific literature are the trichothecenes, a class of chemically related, biologically active fungal metabolites produced primarily by various species of *Fusarium*. Table E-1 lists some of the toxins in this group and producing fungi. The fungi are well-known plant pathogens that frequently invade many agricultural products.

Trichothecene toxins, perhaps more than any other mycotoxins, have been associated with acute disease in humans. Most of the human intoxications have occurred in the Soviet Union (Table E-2). The earliest recognized outbreak occurred in 1891 in the Ussuri district of eastern Siberia. Humans who consumed contaminated grain exhibited headache, chills, nausea, vomiting, vertigo, and visual disturbances. Dogs, horses, pigs, and domestic fowls reportedly were affected.

The most extensive mycotoxicosis outbreak reported to have caused multiple fatalities in man also occurred in the Soviet Union. In 1944, 30% of the population of Orenburg district, near Siberia, was affected by alimentary toxic aleukia (ATA), a disease later shown to be caused by ingestion of trichothecene toxins. More than 10% of the entire population of the district died of the disease. Many other outbreaks of ATA occurred in the Soviet Union, mainly during the 1942-47 period. The contamination was traced to overwintered millet, wheat, and barley infected with *Fusarium*. Symptoms of the disease included vomiting, skin inflammation, multiple hemorrhaging (especially of the lung and gastrointestinal tissue), diarrhea, leukopenia, and suppression of bone marrow activity.

In 1939, Premier Joseph Stalin dispatched Nikita Khrushchev to the Ukraine to organize and improve agricultural operations and to identify the disease causing the deaths of many horses and cattle. The problem was traced to hay and straw contaminated with *Stachybotrys atra*. The disease, later referred to as stachybotryotoxicosis, occurred after ingestion or contact with the contaminated grain. Symptoms included ulcerative dermatitis, peroral dermatitis, blood dyscrasias, hemorrhagic syndromes, abortion, and death. The greatest economic impact was due to loss of horses, although cattle, sheep, poultry, and humans also were affected.

Other disease outbreaks in which similar symptoms were present occurred in 1958 and 1959 among horses and cattle in the Soviet Union and Eastern Europe; thousands of animals were lost. Other intoxications were reported later

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in Japan, Europe, the Soviet Union, and the United States, affecting various domestic animals and—in the case of "red mold toxicosis"—man. All of these diseases have now been shown to be due to ingestion of trichothecenes rather than to an infectious agent. In earlier outbreaks, the levels of toxin present in the contaminated grain were not measured; however, the levels of nivalenol and/or deoxynivalenol measured in toxic grains implicated in more recent outbreaks (i.e., "moldy corn toxicosis" and "red mold toxicosis") typically were between 2 and 8 ppm.

Natural Occurrence of Trichothecene Mycotoxins

Publications concerning the occurrence of trichothecenes are relatively scarce because of the lack of convenient detection methods and the complexity of the trichothecene family of compounds. Only recently have scientists developed methods capable of distinguishing between close structural derivatives and accurately quantifying the levels of toxin present (see Table E-3 for comparison of analytical methods). Extreme care must be taken when reviewing the scientific literature on natural occurrence of these compounds because erroneous conclusions can be drawn on the basis of results obtained with inadequate analytical techniques. Misidentification of compounds and gross overestimation of concentrations have occurred using techniques such as thin layer chromatography.

Table E-4 lists the reports of natural occurrence of T-2 toxin, diacetoxyscirpenol, and nivalenol that were obtained from a literature search of more than 3,000 citations concerned with trichothecene toxins. Levels that are questionable on the basis of techniques used are indicated. It is immediately apparent that the levels of toxins found in the various samples from Laos and Kampuchea are highly unusual, even if one accepts the questionable reports in Table E-4 as valid. The levels of these toxins (150 ppm of T-2 toxin, 109 ppm of nivalenol, more than 100 ppm of diacetoxyscirpenol, and 66 ppm of deoxynivalenol) are markedly higher than those reported to occur in nature. It should also be noted that the incidences recorded in Table E-4 concern levels of toxin produced when *Fusarium* is growing on its ideal substrate, while the Laos and Kampuchea samples were taken from surfaces—rocks and water—that would be extremely unlikely to support *Fusaria* growth and toxin production. Higher levels of toxin production can, of course, be induced when the mold species is grown in pure culture under ideal laboratory conditions; for instance, the Soviets have succeeded in producing 4 grams of T-2 per kilogram of substrate. In a natural environment, however, the *Fusaria* species cannot compete well with other molds such as species of *Aspergillus* and *Penicillium,* and levels of toxin produced are orders of magnitude lower.

The conclusion that the levels of toxins found in the Southeast Asia samples could have occurred only by means of an unnatural mechanism is also strengthened by surveys of the area conducted

TABLE E-1
Trichothecene-Producing Fungi

Type	T-2 Type	Nivalenol-Type	Macrocyclic
Trichothecenes	T-2 Toxin	Nivalenol	Roridins
	HT-2 Toxin	Monoacetyl-Nivalenol	Veirucarins
	Diacetoxyscirpenol	Diacetyl-Nivalenol	Satratoxins
	Neosolaniol	Deoxynivalenol	Vertisporin
Fungus	F. tricinctum	F. nivale	Myrothecium verrucaria
	F. roseum	F. opisphaeria	
			M. roridum
	F. equiseti	F. roseum	
	F. sporotrichioides		Stachybotrys atra
			Verticimonosporium diffractum
	F. lateritium		
	F. poae		
	F. solani		
	F. rigidiusculum		
	F. semitectum		

TABLE E-2
Historical Trichothecene Mycotoxicoses

Toxicosis	Districts and Affected Species	Symptoms
"Taumelgetreide" Toxicosis	U.S.S.R.: man, farm animals	Headache, nausea, vomiting, vertigo, chills, visual disturbances
Alimentary toxic aleukia	U.S.S.R.: man, horse, pig	Vomiting, diarrhea, multiple hemorrhage, skin inflammation, leukopenia, angina
Stachybotryotoxicosis	U.S.S.R., Europe: horse	Shock, stomatitis, hemorrhage, dermal necrosis, nervous disorders
Bean-hull toxicosis	Japan: horse	Convulsion, cyclic movement
Dendrodochiotoxicosis	U.S.S.R., Europe: horse	Skin inflammation, hemorrhage
Moldy corn toxicosis	United States: pig, cow	Emesis, hemorrhage
Red mold toxicosis	Japan, U.S.S.R.: man, horse, pig, cow	Vomiting, diarrhea, congestion and hemorrhage of lung and intestine

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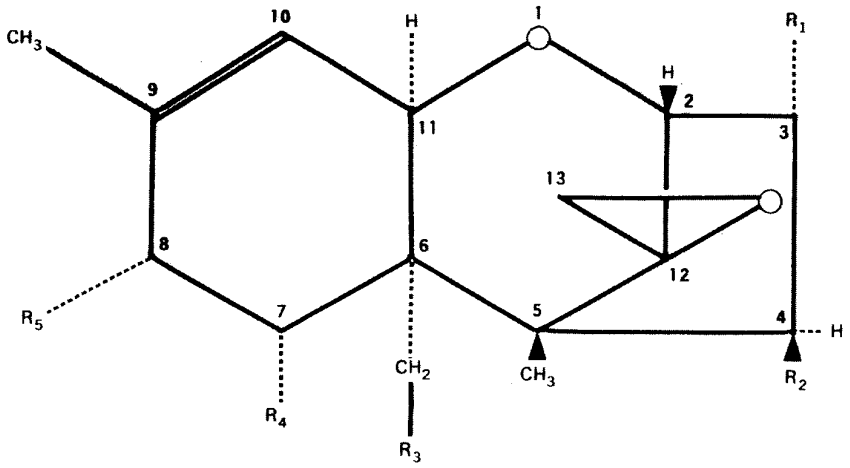
by various researchers. Surveys of the toxigenic fungi and mycotoxins naturally present in Southeast Asia conducted by the Mahidol University in Bangkok and the Massachusetts Institute of Technology have not revealed the presence of T-2, nivalenol, deoxynivalenol, or diacetoxyscirpenol, although other mycotoxins such as aflatoxin were identified. These results were confirmed by our analysis, using our own methodology, of normal flora samples of vegetation, soil, water, corn, and rice from Kampuchea that failed to reveal the presence of trichothecenes.

Skeptics have formulated theoretical explanations for the analytical results to support a hypothesis of natural occurrence of these toxins. It was postulated that the trichothecenes found were absorbed through the roots of a plant, translocated to the leaves, and exuded and washed onto the surface of a rock and into water where they were found. A 1981 publication by Jarvis et al. reported a Brazilian shrub that appeared to absorb, translocate, and chemically alter a macrocyclic trichothecene produced by soil fungi. While this citation is used to support a hypothetical mode for natural deposition in Southeast Asia, it should be noted that the plant reported in this publication did not exude the toxin, that the toxin was extremely phytotoxic to all other plants assessed, and that the plant was not capable of de novo trichothecene synthesis. No other trichothecenes have been found to be absorbed and translocated in any other plant in this manner. Control samples of soil and vegetation from Southeast Asia do not support endemic presence of these toxins. The appearance of these particular trichothecene toxins in these high levels in environments generally inhospitable to their formation cannot reasonably be attributed to a natural contamination.

FIGURE E-1
General Structure of Trichothecenes



T_2 Toxin	Nivalenol	Deoxynivalenol
R_1=OH	R_1=CH	R_1=OH
R_2=OAc	R_2=CH	R_2=H
R_3=OAc	R_3=OH	R_3=OH
R_4=H	R_4=OH	R_4=OH
R_5=$OCOCH_2CH(CH_3)_2$	R_5= =O	R_5= =O

Chemical and Physical Properties of the Trichothecenes

When considering the suitability of trichothecenes as agents, factors such as stability, solubility, and ease of production must be considered. The general structure for the trichothecene group is shown in Figure E-1. There are more than 40 currently known, naturally occurring, 12 to 13 epoxytrichothecenes. The R groups may be hydroxyls, acylated hydroxyl groups or esters. The R group for the toxins detected in the sample is shown below the general structure. All of the compounds have in common an olefinic double bond at carbon atoms 9 and 10 and an epoxy group at carbon atoms 12 and 13. These compounds are stable, especially in the solid form. They may be stored for years at room temperature with no loss of activity. They are heat stable with no loss of activity noted after heating for 1 hour at 100° centigrade. The solubility depends on the R groups; highly hydroxylated derivatives are more water soluble. The compounds are also quite stable in solution. Detoxification can be accomplished by treatment with strong mineral acid, which will open the 12 to 13 epoxide bond and abolish all biological activity. Most of the toxins are well absorbed through mucous membranes and some through skin; this property is also a function of the R group.

Some of these compounds have been synthesized chemically; however, biosynthesis employing *Fusarium* species is the most effective way to produce large quantities. In a preliminary search of recent Soviet literature, 50 articles dealing

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TABLE E-3

Physicochemical Methods for Detection of Trichothecenes in Feedstuffs

Method	Trichothecenes Detected	Detection Limits	Required Standards	Use and Limitation
Thin-layer chromatography 1-dimension	All	0.1 microgram/spot (H_2SO_4)	Reference Standard	Qualitative Interference Not confirmatory
Thin-layer chromatography 2-dimension	All	0.1–1.0 microgram/spot (H_2SO_4)	Reference Standard	Qualitative Less interference Confirmatory
Gas-liquid chromatography	Nonhydroxylated or TMS derivatives	0.03–0.05 microgram/microliter injection	Reference Standard	Quantitative Monoglyceride interference Equivocable identification
Gas chromatography/mass spectrometry-normal scanning mode	TMS derivatives	0.02–0.05 microgram/microliter injection	Reference Standard or Spectrogram	Semiquantitative Less interference Unequivocable identification
Gas chromatography/mass spectrometry-selection ion monitoring	TMS derivatives	0.007–0.02 microgram/microliter injection	Reference Standard or Spectrogram	Quantitative Best for complex mixtures Unequivocable identification
Nuclear-magnetic-resonance	All	——	Reference Standard or Spectrogram	Confirmatory Purified toxin structure elucidation
Radio-immunoassay (developmental stage)	T-2 toxin	1–20 nanogram	Rabbit anti-T-2 toxin anti-body	Sensitive Low interference
			HT-2 toxin	Relative structural specificity

with the trichothecenes were reviewed. Of these, 22 dealt with defining optimum conditions for biosynthesis of the compounds. N.A. Kostyunina has reported production of T-2 toxin at levels of 4 grams per kilogram of substrate (normally wheat grain or rice). Many industrial microbiology plants have been identified in the Soviet Union. Some are involved in production of single-cell protein for fodder additives, others produce antibiotics, and the function of still others is unknown. *Fusaria* are produced in the Soviet Union at a facility long reported in the open literature as being a suspected biological warfare agent production and storage facility. This facility, Berdsk Chemical Works, is near the science city of Novosibirsk in Siberia. The only difference between an antibiotic and mycotoxin is their target specificity. Both are produced by fungi, but the mycotoxins are relatively more toxic to man than to microorganisms. Mycotoxins can be produced in good yield employing the same techniques used to produce some antibiotics. Thus, it may be concluded that the Soviets could produce trichothecenes in large amounts. They produce an antibiotic that is a trichothecene derivative, which would provide an ideal cover for agent production facilities.

Medical Effects of the Trichothecenes in Humans

The most prominent symptoms associated with trichothecene poisoning are listed in Table E-2. Striking among these is the rapid onset of vomiting, along with severe itching and tingling of the skin. Hemorrhage of the mucous membranes and bloody diarrhea follow. The symptoms shown in Table E-2 are similar to those reported by victims of trichothecene attacks in Laos, Kampuchea, and Afghanistan. The correlation is striking.

The LD_{50}'s (dose required to produce death in 50% of a test population) of the trichothecenes in laboratory animals range from 0.1 mg/kg to greater than 1,000 mg/kg, depending on the particular toxin, species, and route of exposure. The LD_{50} of T-2 toxin in a cat is 0.5 mg/kg. However, the ED_{50} (dose required to produce a desired physiological effect in 50% of a test population) is much lower. The ED_{50} to produce a vomiting reaction is 0.1 mg/kg; for skin irritation it is in the tenths of microgram range.

Most of the data concerning the toxicological effects of the trichothecenes are derived from animal data in which pure compounds were administered by oral, subcutaneous, intraperitoneal, or intravenous routes. Unfortunately, there are no reports concerning the effects of inhalation of mixtures of the compounds. Therefore, it is difficult to speculate concerning the effects that would be expected in humans exposed to an aerosol of mixtures of these potent toxins. The most useful data concerning exposure in humans were obtained in a phase I clinical evaluation of anguidine (diacetoxyscirpenol) as an anticancer drug. Diacetoxyscirpenol was administered by intravenous infusion. Doses of 3 mg/m^2/day caused immediate onset of nausea, vomiting, diarrhea, somnolence and/or mental confusion, fever, chills, a generalized erythema with a burning sensation, hypotension, dyspnea, stomatitis, hives, and ataxia. Because of the side effects, the treatment was discontinued. The properties which make the use of diacetoxyscirpenol potentially useful as an anticancer drug are the same as those responsible, in part, for its extreme toxicity. It and the other trichothecenes cause extensive damage to rapidly dividing cells such as tumor cells. Unfortunately, the cells of the lining of the gastrointestinal tract and bone marrow are also rapidly dividing, and the effects of the trichothecenes on these cells result in severe, rapid degeneration of these tissues. The compounds also have direct effects on the clotting factors in the blood (that is, a primary effect on Factor VII activity and a secondary effect on prothrombin), which result in excessive hemorrhage following trauma.

The other useful body of clinical data concerning the effects of trichothecenes in humans is drawn from descriptions of the course of the disease in the natural

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TABLE E-4

Spontaneous Occurrence of Trichothecene Mycotoxins

Toxin	Country	Source	Concentration (parts per million)	Reference[a]
T-2 Toxin	U.S.	Mixed feed	0.08[b]	15
	U.K.	Brewer's grains	ND[c]	19
	India	Sweet corn	4[b, d]	5
	Canada	Corn	ND	4
	India	Sorghum	ND[d]	22
	Canada	Barley	25[d]	20
	India	Safflower seed	3–5[d]	6
	U.S.	Corn stalks	0.11[b]	16
	U.S.	Feed supplement	ND	7
	U.S.	Corn	2	8
	U.S.	Mixed feed	0.3	14
	France	Corn	0.02[b]	10
	U.S.	Corn	ND	2
Diacetoxy-scirpenol	U.S.	Mixed feed	0.5	15
	U.S.	Mixed feed	0.38	15
	India	Safflower seed	3–5[d]	6
	India	Sweet corn	14[d]	5
	Germany	Corn	31.5[d]	23
	U.S.	Corn	0.88	21
Deoxynivalenol	U.S.	Corn stalks	1.5[b]	16
	U.S.	Corn	1.8[b]	15
	U.S.	Corn	1.0[b]	15
	U.S.	Corn	0.1[b]	15
	U.S.	Mixed feed	0.04[b]	15
	U.S.	Mixed feed	1.0[b]	15
	U.S.	Mixed feed	1.0[b]	15
	U.S.	Corn	7.4	9
	U.S.	Corn	0.1–25[d]	21
	U.S.	Corn	trace–25[d]	2, 21
	U.S.	Corn	1.1–10.7	26
	U.S.	Corn	41	25
	U.S.	Corn	1.0[b]	17
	U.S.	Oats	5	17
	Japan	Barley	ND	18
	U.S.	Corn	1.0[b]	13
	U.S.	Corn	0.06[b]	13
	U.S.	Mixed feed	0.07[b]	13
	France	Corn	0.6[b]	10
	South Africa	Corn	2.5	11
	Zambia	Corn	7.4	11
	U.S.	Corn	ND	2
	Japan	Barley	7.3	18
	Austria	Corn	1.3	24
	Austria	Corn	7.9	24
	Canada	Corn	7.9	24
Nivalenol	Japan	Barley	ND	18
	France	Corn	4.3[b]	10
Partially characterized trichothecenes	U.S.	Corn	ND	25
	India	Safflower seed	ND[d]	6
Skin irritant factors—not analyzed chemically	U.S.	Corn	93 positive[b] of 173	3
	U.S.	Corn	Multiple positive samples	21
	Yugoslavia	Corn	16 positive of 191	1

FOOTNOTES

[a] References:

1. Balzer *et al.* (1977)
2. Ciegler (1978)
3. Eppley *et al.* (1974)
4. Funnel (1979)
5. Ghosal *et al.* (1978)
6. Ghosal *et al.* (1977)
7. Hibbs *et al.* (1974)
8. Hsu *et al.* (1972)
9. Isshi *et al.* (1975)
10. Jemmail *et al.* (1978)
11. Marasas *et al.* (1977)
12. Miller (1976)
13. Mirocha (1979)
14. Mirocha (1979)
15. Mirocha *et al.* (1976)
16. Mirocha *et al.* (1979)
17. Mirocha *et al.* (1979)
18. Morooka *et al.* (1972)
19. Petrie *et al.* (1977)
20. Puls and Greenway *et al.* (1976)
21. Romer, T., Ralston Purina, St. Louis, MO (personal communication)
22. Rukmini and Bhat (1978)
23. Siegfried (1979)
24. Vesonder and Ciegler (1979)
25. Vesonder *et al.* (1976)
26. Vesonder *et al.* (1978)

[b] Zearalenone (F-2 toxins) also detected in the sample.

[c] ND = toxin concentration was not determined.

[d] Levels that are questionable on the basis of techniques used.

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outbreaks that occurred in the Soviet Union. The effects produced are similar to radiation poisoning, and there is a latent phase similar to that seen in radiation poisoning, in which the overt symptoms disappear.

The clinical picture may be divided into four stages.

The first stage occurs within minutes to hours after ingestion of toxic grains. The symptomatology described was produced by oral exposure to low doses. In exposure by inhalation, the symptoms may be more pronounced or the time course accelerated. The characteristics of the first stage include primary changes, with local symptoms, in the buccal cavity and gastrointestinal tract. Shortly after ingestion of toxic grain, the patient experiences a burning sensation in the mouth, tongue, throat, palate, esophagus, and stomach as a result of the toxin's effect on the mucous membranes. The tongue may feel swollen and stiff, and the mucosa of the oral cavity may be hyperemic. Inflammation of the gastric and intestinal mucosa occurs, along with vomiting, diarrhea, and abdominal pain. In most cases excessive salivation, headache, dizziness, weakness, fatigue, and tachycardia accompany the initial stage. There may be fever and sweating, but the body temperature normally does not rise. The leukocyte count may begin to decrease in this stage, and there may be an increased erythrocyte sedimentation rate. This first stage may last from 3 to 9 days.

The second stage is often called the latent stage or incubation period because the patient feels well and is capable of normal activity. It is also called the leukopenic stage because its main features are disturbances in the bone marrow and the hematopoietic system, characterized by a progressive leukopenia and granulopenia and a relative lymphocytosis. In addition, anemia and a decrease in erythrocytes, in the platelet count, and in hemoglobin occur. Disturbances in the central nervous system and autonomic nervous systems may occur as well as weakness, vertigo, fatigue, headache, palpitations, and mild asthmatic conditions. Visible hemorrhagic spots (petechiae) begin to appear on the skin, marking the transition to the third phase. The second stage may last 3–4 weeks. The transition to the third stage is sudden, and symptoms progress rapidly.

In the third stage, petechial hemorrhages occur on the skin of the trunk, arms, thighs, face, and head. They can vary from a millimeter to a few centimeters in size. Capillaries are fragile, and any slight trauma results in hemorrhage. Hemorrhages of the mucous membranes of the mouth, tongue, soft palate, and tonsils occur. Nasal, gastric, and intestinal hemorrhages can be severe. Areas of necrosis begin to appear on the lips, fingers, nose, jaws, eyes, and in the mouth. Lymph nodes are frequently enlarged, and the adjoining connective tissue can become so edematous that the patient has difficulty opening his mouth. Blood abnormalities previously described are intensified. Death may occur from hemorrhage, strangulation due to swelling, or secondary infection.

The fourth stage is convalescence. Three or 4 weeks of treatment are required for disappearance of necrotic lesions and hemorrhagic effects. Two months or more may elapse before the bloodforming capability of the bone marrow returns to normal. ■

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Special
Report No. 104

United States Department of State

Chemical Warfare in Southeast Asia and Afghanistan: An Update

Report from
Secretary of State
George P. Shultz

November 1982

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THE SECRETARY OF STATE
WASHINGTON

TO THE CONGRESS OF THE UNITED STATES
AND MEMBER STATES OF THE UNITED NATIONS:

Chemical and toxin weapons are of special concern to mankind. Used against civilian populations, or even against soldiers with protective equipment, they can cause protracted and indiscriminate physical and psychological suffering and, as we witnessed in World War I, widespread death as well. For such reasons, the international community has outlawed the use of these weapons. The 1925 Geneva Protocol, one of the oldest arms control agreements still in force, forbids the use of chemical and biological weapons in war. The 1972 Biological and Toxin Weapons Convention prohibits the mere possession of toxin weapons. In an effort to extend such legal constraints still further, the United States—together with other countries in the Committee on Disarmament at Geneva—is seeking an outright ban on the development, production and stockpiling of chemical weapons.

I regret, then, to report that chemical and toxin weapons are nevertheless being used today in Laos, Kampuchea and Afghanistan by the Soviet Union and its allies. In March of this year, we reported on this subject to the Congress, the United Nations, and to the members of the international community. Our report, which contained a comprehensive and detailed compilation of the evidence available to the United States Government, was designed to bring the issue to the attention of the world community. In presenting it, we invited others to join us in examining the evidence and in confirming the truth.

These efforts have not led the Soviets and their allies to halt their illegal use of chemical and toxin weapons. Instead, they continue to deny the truth about their illegal activities. The world cannot be silent in the face of such human suffering and such cynical disregard for international law and agreements. The use of chemical and toxin weapons must be stopped. Respect for existing agreements must be restored and the agreements themselves strengthened. Respect for the dignity of humanity must be restored. Failure to achieve these goals can only have serious implications for the security of the world community, particularly for the security of smaller nations, like those whose people are being attacked. If such basic elements of human rights can be so fundamentally ignored, how can we believe any pledges to respect human rights?

All who would seek to promote human rights, and all who would seek to maintain the credibility of international agreements, have a duty to call world attention to the continuing use of chemical and toxin weapons, and to seek a halt to their use. It is for this purpose that the United States provides the following report.

Sincerely,

George P. Shultz

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This report presents conclusions based on further evidence about chemical and toxin warfare activities in Laos, Kampuchea, and Afghanistan that has become available to the U.S. Government since publication of the special report on this subject on March 22, 1982. The evidence includes new information on events occurring since the first of this year as well as additional information from a variety of sources on activities described in that report. The current report is accompanied by tables listing recent and newly reported attacks and annexes providing additional sample analysis results, medical evidence, and other supporting data.

UPDATED FINDINGS

Based on a thorough analysis of this new information, we are able to conclude the following:

- Reports of chemical attacks from February through October 1982 indicate that Soviet forces continue their selective use of chemicals and toxins against the resistance in Afghanistan. Moreover, new evidence collected in 1982 on Soviet and Afghan Government forces' use of chemical weapons from 1979 through 1981 reinforces the previous judgment that lethal chemical agents were used on the Afghan resistance. Physical samples from Afghanistan also provide new evidence of mycotoxin use.
- Vietnamese and Lao troops, under direct Soviet supervision, have continued to use lethal and incapacitating chemical agents and toxins against the H'Mong resistance in Laos through at least June 1982.
- Vietnamese forces have continued to use lethal and incapacitating chemical agents and toxins against resistance forces in Kampuchea through at least June 1982.
- Trichothecene toxins were found in the urine, blood, and tissue of victims of "yellow rain" attacks in Laos and Kampuchea and in samples of residue collected after attacks.
- We continue to find that a common factor in the evidence is Soviet involvement in the use of these weapons in all three countries. Continued analysis of prior data and newly acquired information about Soviet mycotoxin research and development, chemical warfare training in Vietnam, the presence of Soviet chemical warfare advisers in Laos and Vietnam, and the presence of the same unusual trichothecene toxins in samples collected from all three countries reinforce our earlier conclusion about the complicity of the Soviet Union and about its extent.

INTRODUCTION

Our March study showed that casualties and deaths resulted from chemical attacks in Southeast Asia and Afghanistan and that trichothecene toxins were used in both Laos and Kampuchea. The new evidence shows that these attacks are continuing in all three countries and that trichothecene toxins have been used in Afghanistan as well.

The same rigorous analytical processes employed in our March study, and outlined in detail there, were followed to arrive at the judgments contained in this update. In light of the widespread publicity given the March report, special efforts were made by U.S. Government analysts to preclude being led astray by any possible false reports that might be generated for propaganda or other purposes and to eliminate the possibility of making erroneous judgments about the chemical or toxin agents involved because of tampering or improper handling. Every report has been carefully checked.

The evidence in the March study was based on a broad range of data, including testimony by physicians, refugee workers, journalists, and others. Although some of the new reports are anecdotal, we have been able to corroborate most of them by other sources and sample analysis. Moreover, personal testimony tends to add credence to other accounts which, taken together, form a coherent picture. The material presented in this report represents only a relatively small amount of the total accumulated evidence. This additional information is examined in greater detail in the annexes. Improved sample collection procedures, a better quality of medical histories and physical examinations, documentation including photographs of lesions and hospital charts from Southeast Asia, and interviews by trained personnel have reinforced our earlier conclusions and led to new discoveries.

As international concern about this subject has increased, based on the

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development of evidence from many countries, independent analyses have been initiated by foreign chemical warfare experts, physicians, journalists, and independent nongovernmental scientists and laboratories. Analysts in the United States have found this research very helpful both in supporting their own conclusions and, more importantly, in expanding on them.

SUMMARY OF EVIDENCE

Afghanistan

Evidence indicates that the Soviets have continued the selective use of toxic agents in Afghanistan as late as October 1982. For the first time we have obtained convincing evidence of the use of mycotoxins by Soviet forces through analyses of two contaminated Soviet gas masks acquired from Afghanistan. Analysis and quantification of material taken from the outside surface of one mask have shown the presence of trichothecene mycotoxin. Analysis of a hose from a second Soviet mask showed the presence of several mycotoxins. In addition, a vegetation sample from Afghanistan shows preliminary evidence of the presence of mycotoxins. (See Annex A.)

Our suspicions that mycotoxins have been used in Afghanistan have now been confirmed. Reports during 1980 and 1981 described a yellow-brown mist being delivered in attacks which caused blistering, nausea, vomiting, and other symptoms similar to those described by "yellow rain" victims in Southeast Asia. Because of limited access to survivors who still exhibited symptoms, as well as great difficulties in collecting environmental and other physical samples from attack sites, we were unable to conclude with certainty in the March 22 report that mycotoxins were being used in Afghanistan. We have now concluded that trichothecene mycotoxins have been used by Soviet forces in Afghanistan since at least 1980.

A number of reports indicate that chemical attacks are continuing in 1982. While we cannot substantiate every detail, the pieces of evidence in these reports add up to a consistent picture. For example, a physician in a facility treating casualties among the *mujahidin* (resistance fighters) has reported that he treated 15 *mujahidin* for red skin lesions that he said were caused by Soviet chemical attacks in Qandahar Province in May-June 1982.

TABLE 1

Afghanistan: Reported Attacks, 1982

Date	Village Location	Method of Attack	Form of Material	Persons Killed	Persons Taken Ill
early Feb.	north of Shindand	aircraft	yellow substance	4	?
Feb. 4, 5	south of Shindand	helicopter	yellow substance	0	?
Feb. 19	Badakhshan Province	aircraft	yellow crystals	?	?
May-June	Qandahar Province	helicopter rockets	black, yellow, white gases	3	15
June	Farah Province	aircraft bombs	red, black, white smoke	?	?
June 11	Qandahar Province	aircraft bombs	?	15	30
June	Baghlan Province	helicopter	?	?	?
July	Panjsher Valley	aircraft	nerve gas	0	0
Sept. 13	Lowgar Province	pumped from armored vehicle	gas	73	0
Sept. 20	Lowgar Province	pumped from armored vehicle	gas	?	?
Sept.	Lowgar Province	?	?	7	?
late Sept./ early Oct.	Baghlan Province	aircraft bombs	?	?	?

? = Undetermined

Three *mujahidin* died within 12 hours of one attack in the general area of Maharijat south of Qandahar. The *mujahidin* claimed that Soviet helicopters fired rockets that emitted black, yellow, and white gases on impact. The physician said that the surviving victims failed to respond to conventional medical treatment.

We have received reports that on September 20, 1982, Soviet soldiers poisoned underground waterways in Lowgar Province south of Kabul where the *mujahidin* were hiding. According to a *mujahidin* commander in Pakistan, a similar event occurred in the same province on September 13, 1982, resulting in the deaths of 60 adults and 13 children. These two independent accounts described a Soviet armored vehicle pumping a yellow gas through a hose into the waterways.[1]

[1]We know from other sources that Soviet chemical agent delivery methods include this technique, as reported, for example, by a Cuban emigre trained by the Soviets in the use of chemical weapons.

According to the accounts of the September 1982 attacks, the victims' bodies decomposed rapidly, and the flesh peeled away when attempts were made to move the bodies. Since 1979, *mujahidin* resistance leaders, refugees, journalists, and Afghan defectors have described chemical attacks causing almost identical symptoms. Most reports have described the skin as being blue-black after death. Although such symptoms seem bizarre, the large number of reports from a variety of sources since 1979 suggests that they cannot be dismissed (see our March 22 report, p. 16).

In 1982, a Soviet soldier who defected to the *mujahidin* said in an interview with a British journalist that a Soviet toxic agent, termed "100 percent lethal," causes the flesh to become very soft. The Soviet defector stated that the Soviets maintained stores of "picric acid" (probably chloropicrin, a potentially lethal tear gas), the "100 percent lethal" agent, and an incapacitating

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agent near the cities of Qonduz and Kabul. The defector also reported that:

- Unidentified toxic agents had been used in June 1982 on the highway between Termez and the Salang Pass north of Kabul;
- The "100 percent lethal" agent was delivered by rockets; and
- "Picric acid" and an incapacitating agent were delivered by air-dropped canisters.

The defector stated that the Soviets have been preoccupied with protecting the roads and that chemicals were sprayed by planes along the areas adjacent to highways. Chemical grenades reportedly have been used, but the data are inadequate to allow us to hypothesize about the contents, although some symptoms are indicative of mycotoxins.

The reports of rapid skin decomposition as quickly as 1–3 hours after death continue to concern us. There is no recognized class of chemical or biological toxin agents we know of that could affect bodies in such a way. If we assume occasional inaccuracies in reporting by journalists and survivors of attacks, it is possible that phosgene or phosgene oxime could cause such effects after 3–6 hours but with much less softening of tissues than is consistent with stories of "fingers being punched through the skin and limbs falling off." The reported medical effects of other toxic agent attacks are consistent with use of the nerve agent tabun. We have information that both phosgene oxime and tabun are stored by the Soviets in Afghanistan.

The British journalist, who interviewed the Soviet defector, also reported on two attacks described to him by the *mujahidin*, which have not yet been confirmed. One was an attack in the spring of 1982 on Kaiba, where Soviet soldiers reportedly shot victims already rendered unconscious by a gas; the other was in the summer of 1982 near Herat where Soviet troops reportedly loaded the bodies from a gas attack onto a truck and removed them. Reliable information indicates that the Soviets used chemical bombs against *mujahidin* forces in late September 1982 and in early October 1982 in Baghlan Province.

Our earlier findings are reinforced by several reports received this year about earlier attacks not covered in our March report:

- According to a former Afghan Army officer, in September 1981 a Soviet helicopter sprayed a yellow mist in Paktia Province (Sheikn Amir) causing 16 deaths. The survivors had bloody noses and tears; extensive bleeding was reported in those who died. The Afghan officer described a similar attack in Nangarhar Province during the same month in which four persons were killed.
- In early December 1981, according to interviews with survivors, 15 refugees attempting to escape to Pakistan were attacked by a helicopter using gas; four or five people were killed (the youngest and the eldest), while the rest became unconscious for 5–6 hours. The attack occurred about 60 kilometers northwest of Jalalabad.
- According to a Soviet soldier who served in Afghanistan in 1980 and personally observed the use of chemical weapons, the Soviets dispersed chemicals from fighter-bombers and assault helicopters. He said that an aircraft or helicopter first would drop a container and then, on a second run, drop a bomb, resulting in a mixture of two different chemicals that killed everything within the contaminated area. We believe that the soldier may have been describing the delivery of two separate chemical agents, an occurrence described by other eyewitnesses.
- An Afghan veterinarian recently has described an incident in May 1979 in which 20 people and a number of sheep were killed near Qandahar. Soviet lab technicians explained that the incident resulted from anthrax, but the doctor knew that the explanation did not fit the effects observed. Local Afghans told the veterinarian that Soviet vehicles had been in the area spraying a yellow/white powder before the incident.
- In June 1980, an airport official described seeing 200–300 gas containers painted in greens and browns at Qandahar Airport. The containers averaged 35–40 inches high and 26–30 inches in diameter. A subordinate reported three types of gases in the containers: one causing burning in the throat as well as suffocation; one causing what looked like smallpox and blistering; and one making victims tired and sleepy and unable to run or fight. Further, the subordinate stated that the containers were placed in special casings that were dropped from aircraft and exploded on impact, emitting a large cloud of smoke, usually yellow but sometimes other colors. He said he had heard *mujahidin* describe these gas attacks and had himself seen animals that had been killed by the gases. We lend credence to this report because we know from other evidence that chemicals are stored at Qandahar Airport, which is an important staging area for Soviet military operations.
- Finally, information received this year revealed that a Soviet adviser inspecting sites for housing Soviet troops before the Afghan invasion indicated that Soviet chemical defense forces entering Afghanistan would bring in extensive stores of toxic materials. The adviser indicated that a proposed garrison in Kabul would be inappropriate for the Soviet chemical defense unit because the materials it transported could devastate the city if an accident occurred.

Laos

H'Mong refugees, recounting details of toxic agent attacks and exhibiting severe medical symptoms from exposure to the agents, fled to Thailand every month from January through June 1982. They brought out more samples contaminated by a yellow, sticky substance described as a "yellow rain" dropped by aircraft and helicopters on their villages and crops. We have preliminary reports on attacks as recent as October 1982. We now know that the yellow rain contains trichothecene toxins and other substances that cause victims to experience vomiting, bleeding, blistering, severe skin lesions, and other lingering signs and symptoms observed by qualified physicians. Experts agree that these people were exposed to a toxic agent and that no indigenous natural disease, plant, or chemical caused these unique physical effects.[2]

Laboratory analyses of blood samples from these victims and studies on experimental animals have shown that trichothecene toxins are retained in the body for much longer periods of time than previously thought. Scientific research has shown that the multiple-

[2]See Canadian report to the United Nations: "Study of the Possible Use of Chemical Warfare Agents in Southeast Asia," Dr. H. B. Shiefer, University of Saskatchewan.

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phase distribution pattern in animals includes a secondary half-life of up to 30 days. We believe that the severe skin lesions observed on victims by doctors are also relevant. Victims whose blood proved on analysis to have high levels of trichothecene mycotoxins exhibit such skin lesions.

Descriptions of the 1982 attacks have not changed significantly from descriptions of earlier attacks. Usually the H'Mong state that aircraft or helicopters spray a yellow rain-like material on their villages and crops. In some reports the symptoms are similar to those described in our March 22 study, and we attribute them to the use of trichothecene toxins. However, in many cases there was no bleeding, only abdominal pains and prolonged illness. These symptoms, described in previous years, suggest that another agent or combination of agents is still being used. The explanation is complicated because different symptoms are ascribed to men, women, children, and animals. It is possible that different agents, lower concentrations of the same agents, or climatic conditions have affected the efficacy of the agents.

Medical personnel in Lao refugee camps in Thailand were much better organized in 1982 to screen victims than in past years. Doctors now routinely use extensive questionnaires and conduct comprehensive medical examinations, including some onsite, preliminary blood analysis. Skilled paramedical personnel oversee preparation of blood and serum samples for proper transport and shipment to the United States or other countries for chemical analysis. Some patients with active symptoms are now being monitored extensively over time.

A number of blood samples have been collected from Laos for analysis in the United States. All biological specimens were drawn by qualified medical personnel, and samples were refrigerated until analyzed in the United States. Analysis of these samples shows that trichothecene mycotoxins continue to be used against H'Mong villages. In addition to blood and urine specimens from victims exposed to chemical warfare, we have collected additional physical samples this year. These physical samples consist of more residue of yellow rain containing mycotoxins from the same attacks that yielded human biological specimens positive for these same toxins. (See Annex A.)

TABLE 2

Laos: Reported Attacks, 1982

Date	Village Location	Method of Attack	Form of Material	Persons Killed	Persons Taken Ill
Jan. 3, 6, 11	Phou Bia*	helicopter spray	yellow rain	0	?
Jan. 4	Phou Bia	aircraft	green chemical**	?	?
Jan. 9	Phou Bia	artillery	white/yellow cloud	0	?
Feb. 13	Phou Bia	aircraft spray	yellow rain	0	?
Feb. 21, 22	Phou Bia	helicopter	white powder	0	?
Feb. 28	Phou Bia	helicopter	white powder	10	30
Mar. 10	Phou Bia	helicopter, aircraft	red, yellow/ white clouds	many	many
Mar. 17	Phou Bia	helicopter spray	yellow rain**	20	?
Mar. 25	Phou Bia	helicopter spray	yellow rain**	1	40 families
late Mar., early Apr.	Phou Bia	aircraft	yellow rain**	27	many
Apr. 1	Phou Bia (3 villages)	?	yellow rain	many	4
Apr. 17, 18, 30	Phou Bia	aircraft	yellow rain	10	?
Apr./May	Phou Bia	aircraft, helicopters	yellow rain	0	many
May 20	Phou Bia	aircraft	yellow rain	4	100
May 24	Phou Bia	aircraft	yellow rain	9	many
May	Phou Bia	poisoned river	?	0	many
June 17	Phou Bia	aircraft spray	yellow rain	4	many

? = Undetermined

*Phou Bia refers to mountain area where H'Mong villages are located.

**Samples from this attack contained mycotoxin (see Annex A).

The number of reported attacks in Laos in 1982 did not differ significantly from the frequencies reported for comparable periods in the years 1977 through 1981. Reported fatalities per attack during 1981 and 1982 showed an apparent decrease, suggesting the possibility that less lethal toxic agents, or lower concentrations of the same agents, are now being used. This apparent decrease, however, was not statistically significant and could have been caused by a number of other factors, including the following:

- Due to emigration and the high number of fatalities since at least 1976, the H'Mong were living in smaller, more scattered communities.
- H'Mong survivors still in Laos were warier and quicker to take cover and to use rudimentary protective measures at the first sign of attack.
- The H'Mong were not taking time to count victims—this is supported by the existence of very few reports that indicate the precise number of people affected by a toxic agent attack.

As stated in the March report, the Soviet Union maintains in Laos significant numbers of advisers who provide maintenance assistance, technical support, and training in both conventional and chemical warfare. A former Lao transport pilot who defected early this summer has described the aerial movement, under Soviet supervision, of toxic agents within Laos.

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Kampuchea

Most reports of toxic attacks in Kampuchea for the period 1978–June 1982 come from Democratic Kampuchean (DK) sources, including interviews with DK military personnel. Evidence from other sources confirmed most of these reports. In 1982, most reported attacks occurred near the Thai border, making it easier to obtain samples and other direct evidence of toxic agent use.

In the first 6 months of 1982, the number of reported toxic agent attacks in Kampuchea was about half the number reported during the same periods in 1980 and 1981. The number of reported deaths per attack also decreased, but data were insufficient to determine if this decrease was statistically significant. We also have preliminary reports on attacks through early November 1982.

In February and March 1982, several attacks occurred just across the Kampuchean border in Thailand. Analysis of samples collected from the attacks was performed in Canada, Thailand, and the United States. Although differing sampling techniques give rise to significant sampling error and lead to slightly different analytical results, both the U.S. and Thai analysts, using different analytical techniques, found trichothecene mycotoxins in their samples.[3] The Canadian team investigating these attacks has published a detailed medical assessment of the victims' symptoms; it concluded that illness had in fact occurred and was caused by a toxic agent, although preliminary tests for trichothecenes proved inconclusive in the Canadian sample.

Blood and urine samples from Kampuchean victims of a toxic agent artillery attack on February 13, 1982, contained trichothecene toxins (Annex A). In addition, post-mortem tissue from a victim of this same attack confirmed the presence of trichothecene toxins (Annex B). Analysis of additional samples showing the presence of trichothecenes taken from other attacks is also found in Annex A.

The Vietnamese conducted toxic agent attacks this year against another resistance group, the Kampuchean People's National Liberation Forces. On several occasions in March-May 1982, the resistance camp at Sokh Sann was hit with toxic artillery shells and bombs. Samples of contaminated vegetation and yellow residue from these attacks

TABLE 3

Kampuchea and Thailand: Reported Attacks, 1982

Date	Village Location	Method of Attack	Form of Material	Persons Killed	Persons Taken Ill
Kampuchea					
Feb. 13	border near Khao Din	artillery	?*	1**	100
Feb. 23	border near Pailin	spread along border	yellow powder	0	?
Mar. 3	Battambang Province	artillery	?	0	?
Mar. 5, 7	Pailin area	aircraft spray, artillery	white powder*	0	10
Mar. 7–11	Sokh Sann	artillery, ground spray	yellow substance	0	many
Mar. 10	Battambang Province	aircraft	toxic substance	25	12
Mar. 10–13	Battambang Province	aircraft, artillery	toxic substance	30	?
Mar. 17	Sokh Sann	artillery	yellow/white powder	0	many
Mar. 24	Battambang Province	poisoned water	yellow powder	4	?
Apr. 29	Battambang Province near border	aircraft spray	yellow powder	3	7
May 23, 26	Sokh Sann	aircraft spray	?	0	?
June	Preah Vihear Province	poisoned food and water	?	2	many
June 24	border near Nong Chan	mortar	yellow cloud	0	4
Thailand					
Feb. 19	Pong Nam Ron District	aircraft spray	yellow powder*	0	many
Mar. 3	southeast of Pong Nam Ron District near border	aircraft (powder wind-blown over border)	powder	0	many
Mar. 5	Pong Nam Ron District	mortars	gray/black smoke	0	18
Mar. 6, 8	southeast of Pong Nam Ron District near border	aircraft spray	yellow powder	0	many

? = Undetermined

*Samples from this attack contained mycotoxin (see Annex A).

**See Annex B for detailed analysis of autopsy results of the victim.

[3]It was thought initially that a harmless yellow powder had been dropped on Thai villages as part of a disinformation campaign attempting to discredit U.S. sample analysis results. Within days of such an attack, the Thai Ministry of Health announced that only ground-up flowers had been found. However, Thai officials later stated that further analysis showed traces of toxin and that the earlier Health Ministry announcement was based on incomplete investigation.

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are now being analyzed. Attacks occurred in Kampuchea through June 1982, providing new samples; qualitative tests indicate that the presence of trichothecenes is probable. The results of confirmatory analyses are pending.

Several Vietnamese military defectors from Kampuchea have provided valuable information in 1981 and 1982 on chemical weapons use and on the Vietnamese chemical warfare program and have reported that some types of agents are supplied by the Soviet Union. Information from other sources also confirms our earlier view that the Vietnamese possess toxic agent munitions and are equipping their own troops with additional protective equipment.

ANNEX A

Analysis of Samples for Chemical Warfare Agents and Toxins

The identity of the agents and toxins being used in Laos, Kampuchea, and Afghanistan cannot be determined without collection and analysis of at least one of the following: environmental or physical samples contaminated with agent, the munitions used to deliver agents, or biological specimens from attack victims.

The likelihood of detection of chemical agents and toxins in contaminated samples depends on a number of factors. These include the persistency of the agent; the ambient temperature; rainfall; wind conditions; the media on which the toxic agent was deposited; and the time, care, and packaging of the sample from collection to laboratory analysis. Many standard chemical warfare agents and toxins disappear from the environment within a few minutes to several hours after being dispersed. These include, for example, the nerve agents sarin and tabun, the blood agents hydrogen cyanide and cyanogen chloride, the choking agents phosgene and diphosgene, and the urticant phosgene oxime. Other standard agents—such as the nerve agents VX and thickened soman and the blistering agents sulfur mustard, nitrogen mustard, and lewisite—may persist for several days to weeks depending on weather conditions. The trichothecene toxins are stable under laboratory conditions but degrade in field samples due to metabolism by micro-organisms contained in the sample. To maximize the chances of detection, sample collections should be made as rapidly as possible after a toxic agent assault; with many agents this means minutes to hours. Given the situation in Southeast Asia and Afghanistan, this usually has not been possible. Although numerous samples were collected, few held any realistic prospect for yielding results. However, when immediately collected and properly handled and using the advanced technology now available, trichothecenes may be detected in both physical and biological materials up to several months after the attack.

Samples have been collected from Southeast Asia since mid-1979 and from Afghanistan since May 1980. To date, more than 350 individual samples—of greatly varying types and utility for analytical purposes—have been collected and analyzed for the presence of traditional chemical agents. About 100 additional samples are pending completion of analysis. All environmental and nonmedical samples were submitted to the U.S. Army Chemical Systems Laboratory for analysis for traditionally recognized chemical warfare agents and other toxic materials. Tissue specimens and body fluids from attack victims were submitted to the Armed Forces Medical Intelligence Center. Under the sponsorship of that organization, the biomedical specimens were analyzed for the presence of trichothecene mycotoxins and other toxins by Dr. Chester Mirocha, University of Minnesota; Dr. Joseph Rosen, Rutgers University; and Dr. Tim Phillips, Texas A&M University.

To date, biomedical samples (blood, urine, and/or tissue) from 33 alleged victims have been screened. Specimens from 16 of these individuals show the presence of trichothecene mycotoxins. In addition, six environmental samples from alleged attack sites have been analyzed by Dr. Mirocha. Five show the presence of unusually high concentrations and combinations of trichothecene mycotoxins.

Evidence of Chemical and Toxin Agent Use in Southeast Asia and Afghanistan, 1982

Sample	Result
Laos	
blood	trichothecene toxin
blood (post-mortem)	trichothecene toxin
yellow residue	trichothecene toxin
vegetation	trichothecene/ aflatoxin B1
Kampuchea/Thailand	
blood	trichothecene toxin
urine	trichothecene toxin
tissue (autopsy)	trichothecene/ aflatoxin B1
yellow residue	trichothecene toxin
vegetation	trichothecene toxin
water	trichothecene toxin
water	cyanide
Afghanistan	
gas mask (two sets)	trichothecene toxin
vegetation	trichothecene toxin

Details concerning samples analyzed since the March report—including the circumstances of their collection, analysis, and the results—are provided in this annex. Results of analysis of earlier samples were included in our March 22, 1982 report.

POSITIVE SAMPLE RESULTS

Afghanistan

One-quarter of the external surface of a Soviet gas mask, obtained near Kabul in September 1981, was recently processed for analysis, employing techniques not previously used, and showed the presence of T-2 toxin. This analysis has been verified by two other laboratories. Similar analysis of material from the hose connections of another Soviet gas mask removed from a dead Soviet soldier in December 1981 in Afghanistan is indicative of the presence of the trichothecene toxins, T-2, DAS, verricarol, and another type of mycotoxin—zearalenone. It is believed that these

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protective masks were worn during operations in which a toxin agent was used.

Preliminary analysis of a third sample acquired in February 1982 also indicates the presence of trichothecenes.

Laos

1) Blood samples were drawn from an ill H'Mong couple on March 21, 1982, by a physician in the Ban Vinai refugee camp. The victims were exposed to toxin agent attacks on November 11, 1981, and January 4, 1982. They remained ill and under treatment on March 21, 1982, when blood samples were obtained. During the November 1981 attack, an aircraft sprayed a yellowish agent. Although no one died in the village, symptoms such as bloody diarrhea were experienced by most of those exposed. In the January 1982 attack, a greenish chemical was sprayed from an airplane. Vomiting with blood, bloody diarrhea, blurred vision, chest pain, eye irritation, and skin rash were reported. Lingering effects included rash, pain in the joints, and fatigue. The blood samples were analyzed for three trichothecene toxins: DAS, T-2, and HT-2. The blood sample from the male was found to contain 13.5 ppb T-2 toxin. The female was negative for all toxins analyzed.

2) Three blood samples were drawn by a U.S. physician on April 17, 1982, from three H'Mong refugees: Bloc Her, an 8-year-old boy; Tong Her, a 6-year-old boy; and Xia Sue Xiong, a young girl. They were among a group exposed to a toxic agent attack in late March 1982 in Laos. The agent used was described as being yellow to reddish brown. It was sticky and dried to a powder. Bloc Her had been severely ill with bloody diarrhea and coughing of blood. Xia Sue Xiong was suffering from bloody diarrhea and abdominal pain. The blood samples were analyzed for three trichothecene toxins: DAS, T-2, and HT-2.

Trichothecene Toxin Analysis

Victim	DAS	T-2	HT-2
Bloc Her	negative	negative	negative
Tong Her	negative	110 ppb	296 ppb
Xia Sue Xiong	negative	46 ppb	negative

ppb = parts per billion

3) Post-mortem blood samples were taken from a 25-year-old H'Mong refugee who had been admitted earlier to a refugee hospital at Ban Vinai, Thailand. Just before death he had suffered from a massive gastrointestinal hemorrhage. He had claimed exposure to a toxic agent attack sometime earlier in Laos. The blood was drawn in the hospital on April 17, 1982, and analyzed for three trichothecene toxins: DAS, T-2, and HT-2.

Trichothecene Toxin Analysis

Specimen Type	DAS	T-2	HT-2
heparinized blood	negative	15 ppb	19 ppb

4) Blood was drawn on April 6, 1982, from Neng Xiong, a H'Mong refugee in Thailand. She was suffering from the effects from a toxic agent attack that occurred in Phou Bia, Laos, on March 25, 1982. The entire population of the village (40 families) suffered from vomiting, fever, backaches, headaches, and chest pain after a helicopter dropped a yellowish agent. Many villagers also developed swollen eyes. It was reported that one woman and several animals died. Neng Xiong's blood was analyzed for three trichothecene toxins: DAS, T-2, and HT-2.

Trichothecene Toxin Analysis

Specimen Types	DAS	T-2	HT-2
heparinized blood	negative	100 ppb	8 ppb
non-heparinized blood	negative	33 ppb	34 ppb

5) A H'Mong refugee reported being subjected to a toxic agent attack on March 17, 1982, in Phou Bia, Laos. The agent, which "looked like yellow rain," was sprayed by a helicopter at low altitude. The sticky yellow spots dried to a powder in 3–4 hours. Immediately after the attack, the victim developed stomach and chest pains and vomited. Vomiting with blood began later and continued over the next 24 hours. Other symptoms included headache, shortness of breath, dizziness, eye irritation, and vision disturbances. The refugee also developed a rash and blisters. Blood samples were drawn by a physician at Ban Vinai refugee hospital in Thailand on March 31, 1982. The samples were analyzed for three trichothecene toxins: DAS, T-2, and HT-2.

Trichothecene Toxin Analysis

Specimen Types	DAS	T-2	HT-2
heparinized blood	negative	19 ppb	negative
non-heparinized blood	negative	3 ppb	2 ppb

6) Results of analysis of two environmental samples from attack sites in Laos were reported in our March 22 report and are not repeated here. An additional set of environmental samples taken from an allegedly contaminated area in Laos near Phu He was obtained for analysis. Although symptoms were manifested in individuals collecting and handling the sample, no trichothecenes were detected upon analysis.

Kampuchea/Thailand

1) On February 13, 1982, at least 100 Kampuchean soldiers were subjected to an artillery-delivered toxic attack by Vietnamese forces and became ill. The attack took place near the village of Tuol Chrey in an area north of Khao

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Din, about 300 meters from the Thai-Kampuchean border. One individual subsequently died (see autopsy results, Annex B). Reported symptoms included burning eyes, blurred vision, shortness of breath, chest pains, vomiting, and vertigo. Some victims also trembled and generally felt weak. Blood and urine samples were taken from a number of victims at various times after the attack as well as from a control group of individuals living under similar conditions but not subject to the toxic agent attack. Blood and urine samples from the control group were negative for all analyzed toxic agents, including trichothecene toxins.

On February 14, 1982, 1 day after the attack, blood samples were taken from two victims: Pen Nom and Prek Reth. On February 15, a urine sample was taken from Pen Nom, while on February 16, a urine sample was taken from Prek Reth. Both blood and urine samples were analyzed for the presence of the trichothecene mycotoxins T-2 and HT-2.

Trichothecene Toxin Analysis

Victim	Specimen	T-2	HT-2
Prek Reth	blood	18 ppb	22 ppb
	urine	negative	negative
Pen Nom	blood	11 ppb	10 ppb
	urine	trace	18 ppb

On March 4, 1982, 19 days after the incident, some victims still showed effects of the attack and were being treated in Nong Pru hospital in Kampuchea. Further blood samples were drawn at that time from Prek Reth and five additional victims.

Trichothecene Toxin Analysis

Victim	T-2 Toxin
Prek Reth	negative
Kim Ving	7 ppb
Mau Sereth	negative
Seng Nem	negative
Ching Soeum	negative
Chem Ron	3 ppb

Analysis of tissue samples from a victim of the February 13 attack is described in Annex B.

2) On March 5, 1982, a small Vietnamese aircraft sprayed a white powder in an area near Pailin, Kampuchea. On March 6, 1982, 10 of a group of 15 Kampucheans were unable to continue walking due to illness after passing through the area. Symptoms included nausea, vomiting, shortness of breath, blurred vision, diarrhea, bloody discharge from the nose, and burning sensation in the chest and abdomen. A second attack occurred on March 7, 1982, when some of the same Kampucheans were subjected to Vietnamese toxic artillery shelling. The agent produced nausea, dry mouth, and blurred vision and also caused loss of consciousness and muscle twitching. Despite medical treatment, a number of the victims died.

Samples were taken from three survivors exposed to the contaminated area on March 6 and 7. Blood and urine were taken on March 13, 1982.

Trichothecene Toxin Analysis

Victim	Specimen*	DAS	T-2	HT-2
Neung Hon	urine	negative	5 ppb	2 ppb
	blood	negative	7 ppb	negative
Chan Saran	urine	negative	4 ppb	1 ppb
	blood	negative	negative	8 ppb
Bun Thoeum	urine	negative	22 ppb	7 ppb
	blood	negative	negative	negative

*Blood samples were heparinized.

3) A sample of contaminated vegetation was obtained following spraying by a Vietnamese aircraft in Pong Nam Ron District near the Thai-Kampuchean border on February 19, 1982. Analysis of this sample for known chemical agents was negative. However, the trichothecene toxin T-2 was present at a level of 86 ppb. DAS was also present at 30 ppb. The sample was of insufficient size to analyze accurately for the toxins nivalenol and deoxynivalenol.

ANNEX B

Autopsy Results of a Chemical Warfare Attack Victim in Kampuchea

Chan Mann was one of several victims of a February 13, 1982, toxic agent attack in the area of Khao Din. The victim, being treated at Nong Pru Hospital, reportedly made a brief recovery on March 12 and 13, followed by a relapse when he became anuric, feverish, restless, and slightly jaundiced. On March 16, he lapsed into a coma and died. A urinary catheter was inserted approximately 4 hours before death, but only minimal blood-tinged urine was obtained. Shortly before death the victim vomited blood. Kampuchean physicians performed a necropsy. Tissue sections of heart, esophagus/stomach, liver, kidney, and lung were taken and fixed in formaldehyde. Tissue samples were given to both U.S. and Canadian officials for analysis.

The samples delivered to the United States were submitted to several U.S. laboratories for gross, microscopic, histopathological, and chemical-toxicological analysis.

Results of Analysis of Tissue Samples for DAS, T-2, and HT-2[1]

Material	Amount (g)	Toxins Detected DAS[2]	T-2	HT-2
Heart	7.9	—	—[3]	1 ppm
Stomach	13.5	—	25 ppb	4 ppm
Liver	9.5	—	—	—
Kidney	10.4	3 ppm[4]	7 ppb	—
Lung	4.5	—	9 ppb	—
Intestine	5.3	—	88 ppb	10 ppb

[1]DAS (Diacetoxyscirpenol), a trichothecene toxin; T-2, a trichothecene toxin; HT-2, a metabolic product of T-2.

[2]DAS was used as internal standard—i.e., DAS was added to each tissue sample as a standard to check accuracy of analysis. Only the kidney had a concentration of DAS greater than the amount added.

[3]Toxins were not detected. Concentration of DAS was no greater than the added internal standard.

[4]Endogenous DAS in sample detected in concentration greater than the standard.

Note: Tissues were analyzed for trichothecene toxins by Dr. C.J. Mirocha, University of Minnesota. A parallel analysis performed by Dr. J. Rosen, Rutgers University, also revealed the presence of high levels of trichothecene toxins.

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A high incidence of natural aflatoxin contamination of food in Southeast Asia has been well documented. Linderfelser and coworkers (1974) have shown that aflatoxin and T-2 toxin in combination have a synergistic effect and, therefore, it was of interest to determine the extent of aflatoxin in tissue of this individual.

Results of Analysis of Samples for Aflatoxin

Material	Weight of Sample (g)	Sample	
		Actual (ng/g)[1]	Adjusted[2] (ng/g)
Stomach	3.04	19.8	22.5
Liver	3.00	20.2	23.2
Kidney	7.50	15.3	17.4
Intestine	3.02	11.2	12.7

[1]Nanograms per gram.

[2]Values adjusted on basis of 88% recovery—that portion of aflatoxin found when a known amount is added to the sample.

Note: Aflatoxin analyses were conducted by Dr. Phillips, Texas A&M University.

Levels of aflatoxin detected in the tissues were so high that it seemed prudent to investigate the possibility that this individual exposure to aflatoxin was not due to a natural contamination but may have been related to the chemical attack. To this end, portions of the sample of yellow rain from Laos previously shown to contain 143 ppm of T-2 toxin and 27 ppm of DAS were submitted to Dr. Mirocha and Dr. Phillips for analysis for aflatoxin B1. Independent thin-layer chromatography and high-performance liquid chromatography analyses were negative for aflatoxin, supporting a hypothesis that this toxin is not always a component of a yellow rain sample and that the victim's exposure to aflatoxin may have been due to contamination of the food source. It does not, however, rule out the possibility that aflatoxin is a component of some yellow rain attacks. Preliminary analysis of some more recent yellow rain samples indicates the presence of aflatoxin not consistent with a natural contamination. In any case, the findings of aflatoxin in these tissues is important since the high incidence of exposure to natural outbreaks of aflatoxin contamination in Southeast Asia may induce a greater susceptibility to trichothecenes in this population.

Portions of each tissue sample were submitted to Dr. Charles Stahl, University of Tennessee Medical School, for histopathological examination. A summary of the pathology found included: hemorrhage into the heart tissue with evidence of cell destruction and inflammation, cirrhosis of the liver, hemorrhage and cellular destruction of kidney tubules, hemorrhage in the bronchi, and congestion and destruction of the lung. The details of these results and similar findings by other pathologists are consistent with results of analysis of animals exposed to trichothecenes.

No single post-mortem finding proves cause and effect of toxin exposure and death, but these data taken together provide objective evidence that:

- Reports from witnesses of yellow rain attacks are valid and that bleeding sometimes occurs in the lung, stomach, intestine, and kidney or bladder.
- Persons already debilitated by disease or exposure to other toxins have a greater risk of death from trichothecene toxicosis.
- Microscopic examination shows that tissue damage occurs in humans after moderate-to-heavy exposure to trichothecenes. The damage is similar to that found in experimental animals.
- Microscopic damage persists for 1 month or longer.
- Trichothecenes are known to cause long-term damage to rapidly dividing tissue. These toxins accumulate and persist at least in the organs that were examined.
- Aflatoxin found in the tissues may be foodborne and is not necessarily a component of the yellow rain substance. However, aflatoxins and trichothecene toxins act synergistically, and they could be components of a toxic crude extract mixture. Emerging data from several sources lend credibility to such a hypothesis; therefore, investigation seems warranted.

ANNEX C

Discussion of Analytical Findings[4]

The finding of T-2 toxin and HT-2 toxin in blood, urine, and tissue samples from yellow rain victims is highly significant in view of the fact that no trichothecenes could be detected in similar samples from the control population who were not exposed to yellow rain. The finding of such high levels of trichothecenes weeks after exposure is surprising and raises questions concerning the distribution, metabolism, and excretion of these toxins as well as their long-term effects.

Only limited research concerned with elimination rates of the trichothecenes has been conducted. Ueno, et al., 1971, reported that orally administered fusarenon-x was rapidly distributed to the tissues and reached peak levels by 3 hours after dosing. The kidney was believed to be the major organ of excretion. Matsumoto, et al., 1978, conducted studies with T-2 toxin which led him to conclude that the liver and biliary system were the major organs of T-2 excretion. Chi, et al., 1978, administered oral doses of T-2 to broiler chickens. Peak tissue levels were reached by 4 hours after dosing, and the liver contained the greatest amount of toxin. By 12 hours after dosing, however, the muscle, skin, and bile contained the highest amounts of detectable toxin. By 48 hours, 82% of the administered dose had been excreted. Robinson, et al., 1979, showed that T-2 toxin was excreted into cow milk at levels up to 160 ppb after daily administration of 0.6 mg/kg doses.

Studies concerned with metabolism of the trichothecenes have also been limited in number. Yoshizawa, et al., 1980, reported that in rat liver *in vitro* studies with the S-9 fraction of rat liver homogenates, HT-2 made up 50% of the metabolic products. Other metabolites included TMR-1 (19%), TMR-2 (2%), and T-2 tetraol (4%). In *in vivo* studies, HT-2 was one of the major products eliminated in the excreta of chickens (Yoshizawa, et al., 1980) as well as urine, feces, milk, and blood of dairy cattle (Yoshizawa, et al., 1981).

The finding of T-2 toxin and HT-2 in the blood and tissue of humans weeks after their exposure to the toxins would seem to indicate that enough toxin remains bound in body tissues to allow detection by sensitive instrumentation. Trichothecenes have been shown to bind to ribosomal proteins (Ueno, 1975) and to react with sulfhydryl containing compounds such as glutathione (Foster, et al., 1975) and with proteins such as albumin (Chu, et al., 1979). It would appear that although most of the toxin would normally be expected to be excreted within 48 hours after exposure, small amounts of the toxin and its metabolites remain bound to body tissues for much longer periods. The

[4]Based on excerpts from a paper by Dr. C.J. Mirocha and Dr. S. Watson, presented at an international symposium on mycotoxins in Vienna on September 1, 1982.

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size of the dose administered and the route of exposure may have a significant effect on the proportion bound, since a sudden, rapidly absorbed, massive dose may overload normal excretion and detoxification mechanisms, resulting in greater tissue binding of the toxin. Similar apparent long-term storage of mycotoxins has been reported previously for aflatoxin B. Although most of the administered dose of aflatoxin is rapidly metabolized, Shank, et al., 1971, demonstrated in studies of monkeys that unmetabolized aflatoxin B could be detected up to 6 days after administration of a sublethal dose.

Additional significant findings lie in the trichothecenes found in the leaf samples (T-2, DON, nivalenol) and yellow powder (T-2, DAS). The concentrations found and their combination are not normally found in nature and it would appear that these mycotoxins found their way into the environment by the intervention of man. The most compelling evidence is the presence of T-2 and DAS in the yellow powder. Both toxins are infrequently found in nature and rarely occur together. In our experience copious producers of T-2 toxin (*F. tricinctum*) do not produce DAS and, conversely, good producers of DAS (*F. roseum* 'Gibbosum') do not produce T-2. This is also supported by our experience that a good producer of DON does not produce T-2 or DAS but could produce nivalenol. Thus, we have more than just the quantity of toxins produced to explain, but also the kinds that respective species and their isolates produce. Theoretically, it is possible to genetically manipulate or select an isolate that would produce copious amounts of two or more of these toxicants, but this would require a sophisticated research effort and sophisticated technology based on experience.

It is difficult to explain the presence of trichothecenes on leaf surfaces. Fusarium is not a leaf pathogen, and so we would not expect it to colonize leaves indiscriminately. Fusarium does colonize the roots and vascular tissue (causes wilt diseases) of some plants, and it would have to produce the toxins *in situ* and translocate them to the leaves. This has never been demonstrated in the pathogenesis of Fusarium-infected plants. If a pathogen like *F. oxysporum* f. *lycopersici*, pathogenic to tomatoes, were to produce trichothecenes and translocate them to the leaves, one would not expect such high concentrations and combinations of toxins. Moreover, we are not certain that pathogenic isolates of the latter produce trichothecenes during pathogenesis. It is a well known plant pathological principle that production of toxins by pathogens in laboratory culture does not signify that these toxins also are produced in the host.

Apart from the controversy of the trichothecenes occurring on the leaves, it is difficult to imagine a reasonable explanation for the appearance of T-2 and DAS in the yellow powder. To those who claim that they dropped onto the soil and rocks from overhanging leaves, this is contrary to any known facts about trichothecene occurrence or distribution. The burden of proof remains with those alleging such an unlikely hypothesis.

The finding of T-2 toxin, diacetoxyscirpenol, deoxynivalenol, zearalenone, and *Fusarium* pigments in leaves, water, yellow powder, and fragments originating at sites of yellow rain attacks in Southeast Asia and their absence in background samples (leaves, corn, rice, water, soil) from areas not exposed to yellow rain strongly implicates their use as warfare agents. Moreover, the finding of T-2 toxin and HT-2 toxin (a metabolite of T-2 toxin in animals) in the blood, urine, and tissue of victims of these attacks provides unequivocal evidence of their use as weapons.

* * * *

Details of the experimental procedures used in these analyses were presented at the Society of Toxicology meeting in Louisville, Kentucky, on August 16, 1982; at an international mycotoxin symposium in Vienna, on September 1, 1982; and at the Association of Analytical Chemistry meeting in Washington, D.C., on October 28, 1982.

Two scientific manuscripts describing those analyses have been submitted for publication in refereed journals and other studies pertaining to nongovernmental analyses are in press. ■

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Director of
Central
Intelligence

[redacted]

Use of Toxins and Other Lethal Chemicals in Southeast Asia and Afghanistan

Special National Intelligence Estimate
Volume I—Key Judgments

[redacted]

2 February 1982

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USE OF TOXINS AND OTHER LETHAL CHEMICALS IN SOUTHEAST ASIA AND AFGHANISTAN

Volume I—Key Judgments

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THIS ESTIMATE IS ISSUED BY THE DIRECTOR OF CENTRAL INTELLIGENCE.

THE NATIONAL FOREIGN INTELLIGENCE BOARD CONCURS.

The following intelligence organizations participated in the preparation of the Estimate:

The Central Intelligence Agency, the Defense Intelligence Agency, the National Security Agency, and the intelligence organization of the Department of State.

Also Participating:

The Assistant Chief of Staff for Intelligence, Department of the Army

The Director of Naval Intelligence, Department of the Navy

The Assistant Chief of Staff, Intelligence, Department of the Air Force

The Director of Intelligence, Headquarters, Marine Corps

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SCOPE NOTE

This Estimate presents the results of an intensive review by the US Intelligence Community of all available evidence on chemical warfare activities in Laos, Kampuchea, Vietnam, and Afghanistan. It also takes a brief second look at intelligence holdings on the 1963-67 Yemeni civil war and at the Soviet chemical-biological warfare program. The Estimate does not consider the arms control and disarmament aspects of the problem, nor does it examine in any depth the threat implications flowing from the employment of chemical weapons in local conflicts. (U)

While the Intelligence Community is confident of the key judgments which follow, many uncertainties remain concerning the full scope of Soviet activities in the chemical-biological warfare sphere, particularly the USSR's research and development program. (U)

This volume presents the basic Estimate. Volume II, published separately, contains a large amount of supporting data and analysis on the subjects covered in volume I. Volume II also includes a series of technical annexes that provide tabulations of reported attacks, details on the sample analyses, a technical description of trichothecene toxins, a bibliography of Soviet publications on these toxins, and other supporting documents (U)

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KEY JUDGMENTS

Laos

Lao and Vietnamese forces, assisted by Soviet logistics and supervision, have used lethal chemical agents against Hi'Mong resistance forces and villages, causing thousands of deaths since at least 1976. Trichothecene toxins have been positively identified as one of the classes of agents used, but medical symptoms indicate that irritants, incapacitants, and nerve agents also have been employed. (U)

Kampuchea

Vietnamese forces have used lethal trichothecene toxins on Democratic Kampuchean troops and Khmer villages since at least 1978. Again, medical symptoms indicate that irritants, incapacitants, and nerve agents also have been used. (U)

The Soviet Role in Southeast Asia

The one hypothesis that best fits all the evidence is that the trichothecene toxins were developed in the Soviet Union, provided to the Lao and Vietnamese either directly or through transfer of technical know-how, and weaponized with Soviet assistance in Laos, Vietnam, and Kampuchea. There is no intelligence at hand to support alternative explanations, such as completely independent manufacture and use by the Vietnamese. It is highly probable that the USSR also provided other chemical warfare agents. While the evidence on the Soviet role does not constitute proof in the scientific sense, the Intelligence Community finds the case to be thoroughly convincing. (U)

Afghanistan

Soviet forces in Afghanistan have used lethal and casualty-producing agents on Mujahedin resistance forces and Afghan villages since the December 1979 invasion. There is some evidence that Afghan Government forces may have used chemical weapons provided by the USSR against the Mujahedin even before the invasion. No agents have been identified through sample analysis, but we conclude from analysis of all the evidence that attacks have been conducted with irritants, incapaci-

[redacted]

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tants, nerve agents, phosgene oxime, and perhaps trichothecene toxins, mustard, lewisite, and unidentified toxic smokes. (U)

[redacted] (b)

(b) (1)

(b) (3)

Implications

[redacted] (b) (1)

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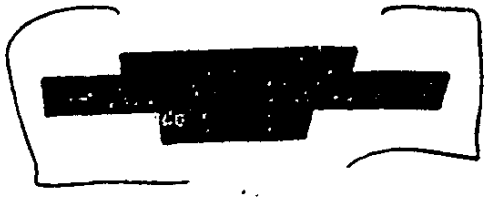


DISCUSSION

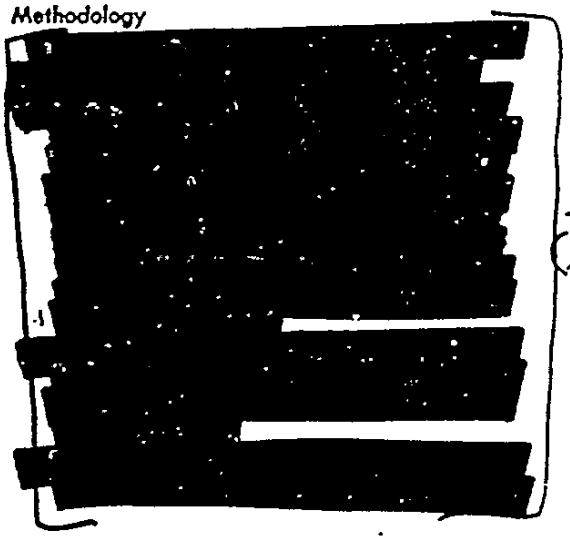
Background

1. In September 1981 the US Government in a public declaration raised the probability that the trichothecene class of toxins[1]—poisonous chemical substances extracted from biological material (specific molds)—was the mysterious lethal agent that had been used for many years in Laos and Kampuchea. This significant statement was precipitated by the discovery of high levels of trichothecene toxins in a vegetation sample collected shortly after a March 1981 Vietnamese chemical attack in Kampuchea. That public declaration, however, rested on a much broader base of evidence than the analysis of that sample. (U)

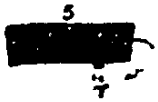
2. In April 1980 the Intelligence Community had already concluded (see volume II, annex F) that lethal agents had almost certainly been used against H'Mong tribespeople in Laos. There was less reliable evidence about the use of lethal agents in Kampuchea, mainly because of suspicions about the propaganda campaign of Pol Pot's Democratic Kampuchean (DK) forces. The DK claims were subsequently shown to be valid. It was also concluded that chances were about even that lethal agents had been used in Afghanistan. There was little doubt by this time that riot control agents and some form of incapacitants had been used in all three countries, although not specifically mentioned in the April 1980 assessment. Since mid-1980, sufficient additional evidence has allowed a much firmer Intelligence Community judgment than that stated in the April assessment. There is now no doubt that deaths and casualties have resulted from chemical attacks in all three countries. (U)

3. Analysis of additional samples from Laos and Kampuchea has revealed at least four trichothecenes, further supporting our conclusion that toxins were used. A review of all the reports indicates the use of many different chemical agents, means of delivery, and types of chemical attacks. In some cases, the symptoms are typical of those caused by trichothecenes, but in many cases the symptoms suggest other agents, which we have not been able to identify through sample analysis. Significant differences as well as similarities have surfaced in the reports from the three countries. The evidence from each country, therefore, is described separately, with attention drawn to similarities where appropriate. A section on the 1963-67 civil war in Yemen is included (see volume II, chapter VI) because of the striking similarities between the chemical warfare activities reported during that conflict and what has been observed in Southeast Asia and Afghanistan. (U)

Methodology



[1] Trichothecene toxins, like all other toxins, are chemical compounds derived from biological material. For purposes of this Estimate, toxins are characterized as chemical warfare agents. Their manufacture, however, would most likely take place in biological warfare facilities, even if the toxins were synthetically produced. (U)



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5. After the data base was organized to permit comparative analysis, the study focused on three separate questions.

— Have lethal and other casualty-producing agents been used in Southeast Asia and Afghanistan?

— What are these agents and how and by whom are they employed?

— Where do the agents originate and how do they find their way to the field? (U)

6. Although the evidential base differs for each country, the analytic approach used was the same. The testimony of eyewitnesses—date, place, and type of attack—was matched against information from defectors, journalists, and international organizations and sensitive information that often pinpointed the time and place of chemical attacks. In addition, the intelligence files on military operations in the areas where chemical attacks had been reported were searched to establish whether air or artillery strikes took place or whether there was fighting in the areas where chemical agents were reportedly used. In all three countries, we identified a number of instances in which eyewitness accounts could be correlated with information from other sources. (U)

7. There is no evidence of any systematic propaganda campaign having been mounted by the H'Mong or the Afghan resistance forces to promote the allegation that chemical agents have been used on their people. Rather it was the US Government, other governments, and private individuals from many countries that publicized the use of chemical agents and that provided the evidence to international organizations. On the other hand, there were early indications that Pol Pot's Democratic Kampuchean resistance did engage in an organized propaganda campaign on chemical agent use. These indications made us very cautious about accepting DK allegations, which increased markedly after the chemical attacks in Laos were publicized. For Kampuchea, therefore, we were particularly insistent in our efforts to confirm allegations made with sources of information that in no way could be part of a propaganda or deception campaign. (U)

Laos

8. Reports of chemical attacks in Laos date from the summer of 1975 to the present. These reports describe 261 separate attacks in which at least 6,504 deaths were cited as having resulted directly from exposure to chemical agents. (U)

9. The actual number of deaths is almost certainly much higher, because the figure above does not take account of deaths in attacks for which no specific casualty numbers were reported. The greatest concentration of reported use of chemical agents occurred in the area where the three provinces of Vientiane, Xiangkhoang, and Louangphrabang adjoin (see map, figure 1). This triborder region accounted for 77 percent of the reported attacks and 83 percent of the chemical-associated deaths. Most of the reported attacks took place in 1978 and 1979. In the past two years, reporting has indicated a low level of chemical activity but continuing high death rates among unprotected and untreated victims—only seven chemical attacks were reported in the fall of 1981, for example, but 1,034 deaths were associated with those incidents. (U)

10. With very few exceptions, these reports are from HUMINT sources, particularly from H'Mong refugees [redacted]

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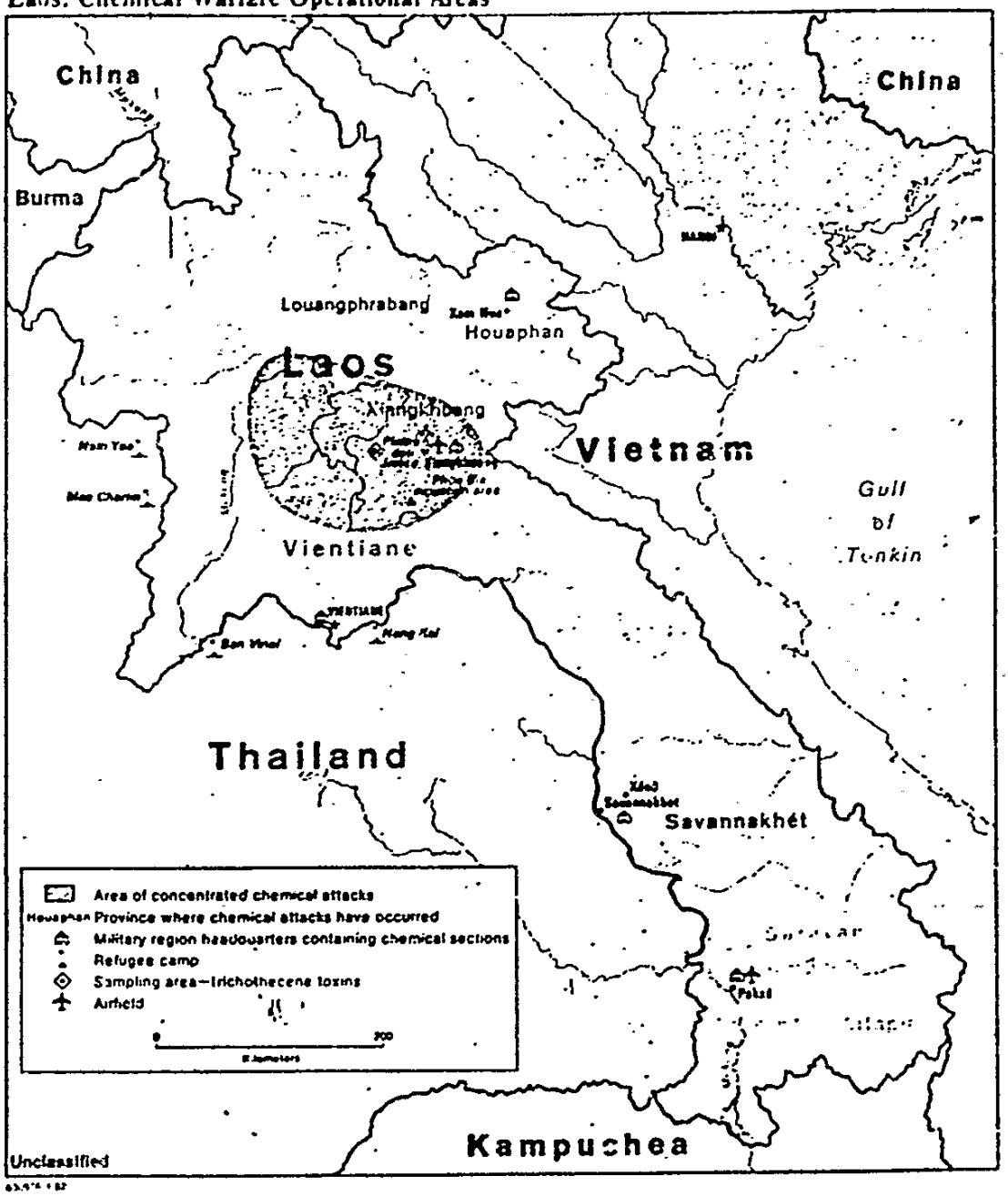
Figure 1
Laos: Chemical Warfare Operational Areas



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[redacted] June 1981 a group of ethnic Lao refugees from Ha Nhan reported that a helicopter from Vientiane had dropped "poison" into the stream near their village. [redacted]

11. One possible explanation for the difficulty in obtaining corroborative data for Laos may simply be the nature of the fighting there. There have been few major operations. Rather, the reports reflect numerous minor engagements between the opposing forces, and results of these encounters are rarely reported. This is consistent with the observation that the resistance forces are splintered, operating in small, discrete units that emphasize sabotage and unconventional warfare. Finally, in nearly all cases, the chemical use reported has been directed against villages, in the absence of obvious combat operations. This substantiates a Lao pilot's claim that the Vietnamese and Laotian military commands were engaged in a "H'Mong extermination" campaign. (U)

12. Of particular interest are the circumstances surrounding the collection of two physical samples that were found to contain lethal toxins. The first sample was collected after a 13 March 1981 attack on a village between the villages of Muong Chai and Phakhao in the Phou Bia region. In this case, a large two-engine plane reportedly sprayed a mist of a moist, yellow, sticky substance; two villagers and all village animals died. The second sample is from Ban Thongnak, another village in the Phou Bia region. That sample was collected following a 2 April 1981 attack in which a jet aircraft reportedly sprayed a yellow substance; 21 of the 450 villagers died. Seven separate chemical attacks, resulting in 218 deaths, were reported to have occurred in this region in the spring of 1981. (U)

13. It is significant that these attacks took place following a period of escalation in overall resistance activities in the Phou Bia area in the winter of 1980-81. During that period, joint suppression operations by LPLA and Vietnamese Army (PAVN) forces had achieved only limited success, perhaps spurring both forces on to greater effort. The more intense use of chemical weapons may have been part of this effort. (U)

14. Every qualified interrogator who systematically interviewed the H'Mong refugees concluded that the latter had been subjected to chemical attacks. For example, the US Government medical team returned from Thailand in 1979 convinced that several unidentified chemical warfare agents had produced the symptoms described by the refugees. It was the testimony of a Lao pilot who flew the chemical warfare missions that helped dispel any lingering suspicions that the refugees had fabricated or embellished the stories. His detailed description of the Lao, Vietnamese, and Soviet program to defeat the H'Mong resistance with chemical agents appears in volume II, chapter I. (U)

15. The Lao pilot described the chemical rocket he had fired as having a more loosely fitting warhead than a conventional rocket. In 1977 a H'Mong resistance leader found a US 2.75-inch rocket with a modified Soviet warhead that fits this description. In further corroboration, a reliable Thai source reported that US 2.75-inch rockets were fitted with lethal chemical warheads by Soviet and Vietnamese technicians at facilities in Vientiane as well as in Xiangkhouang and Savannakhet Provinces. (U)

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Kampuchea

17. For Kampuchea we have reports of 124 separate attacks, from 1978 to the present, in which lethal chemicals caused the deaths of 1,014 individuals. Here again, the mortality figure represents a minimum because some reports state only that there were deaths and do not provide a number. The earliest reports cite attacks in Ratanakiri Province, in the northeastern corner of the country (see map, figure 3). Reports from 1979 to the present show the use of lethal chemicals primarily in the provinces bordering on Thailand. The greatest use of chemical agents apparently has been in Battambang Province (51 reported incidents). Pursat Province has suffered the next highest frequency, with 25 reported incidents. These numbers are consistent with the overall high level of military activity reported in the border provinces. (U)

[redacted]

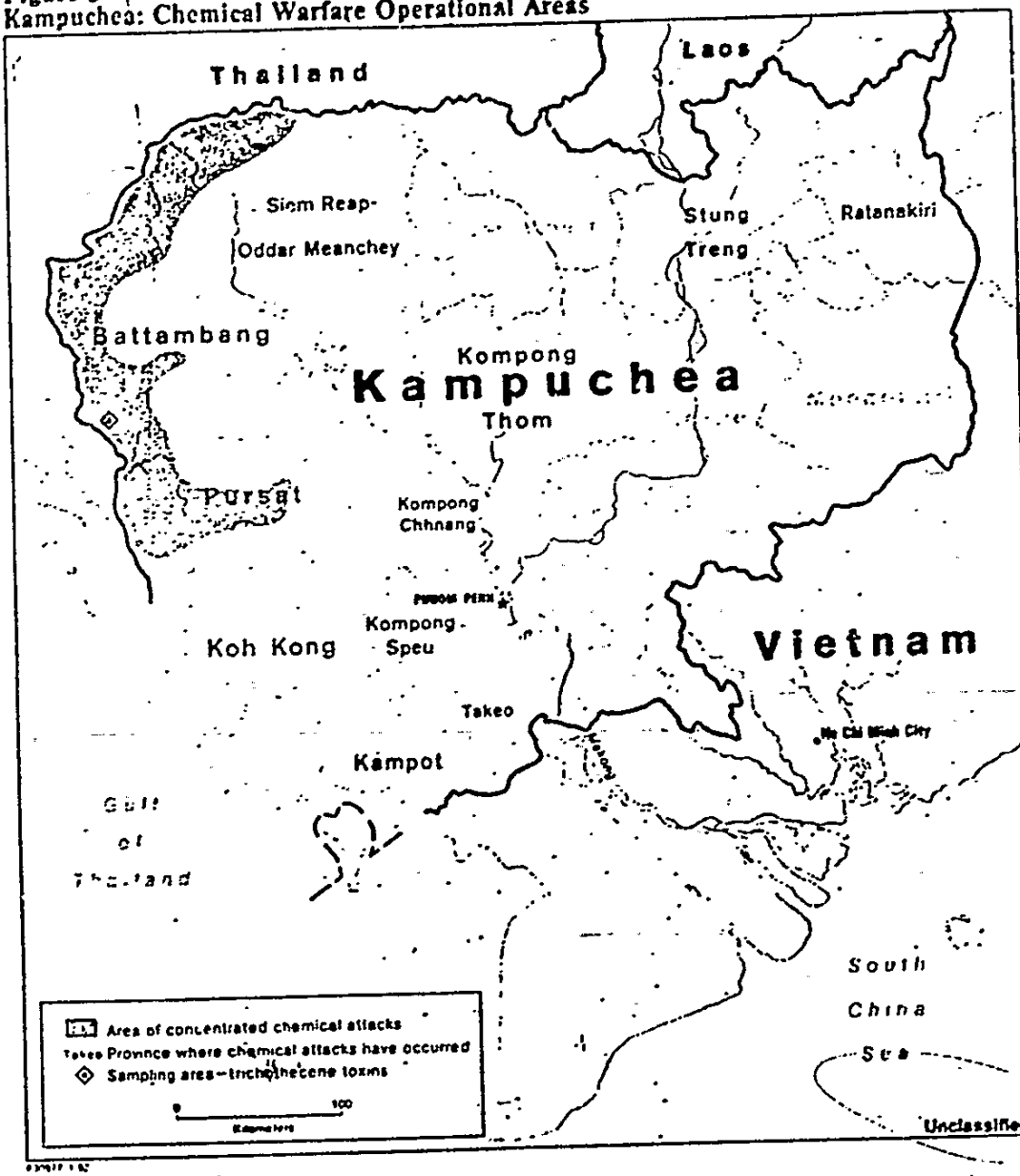
21. US analysis of contaminated vegetation samples from the March 1981 attack showed high levels of three trichothecene toxins in a combination that we would not expect to be found in a natural outbreak in this environment. These three trichothecenes at the levels found on the vegetation would produce the vomiting, skin irritation and itching, and bleeding symptoms. Water samples taken from the area of the same attack also contained trichothecene toxins. Control samples from nearby areas confirmed that these toxins are not indigenous to the locale. (Details on the sample analysis appear in volume II, annex D, and the medical analysis is in volume II, annex E) (U)

[redacted]

[redacted]

[redacted]

Figure 3
Kampuchea: Chemical Warfare Operational Areas



[redacted]

[redacted]

[redacted]

23. In Kampuchea as in Laos, the period of late 1980 through spring 1981 was one of intensified Vietnamese operations to suppress the resistance, and the Vietnamese may have considered the use of toxins an effective means of breaking the will of the opposing forces. (U)

[redacted]

[redacted]

26. The chemicals used in the 19 September Takong attack were dispersed (according to the DK soldiers affected) as a gas or powder, and as a poison to water. The gas or powder was released from containers by tripwires in the area of the rear forces. This description is consistent with the other reporting for this area and time. (U)

[redacted]

[redacted]

Afghanistan

29. Attacks with chemical weapons against the Mujahedin in Afghanistan were reported as early as six months before the Soviet invasion on 27 December 1979. Five separate chemical attacks in this preinvasion period were reported in eastern Afghanistan, but the evidence for this period is inconclusive. The reports specify only that Soviet-made aircraft were used, with no clear identification of Soviet or Afghan pilots, or of the specific agents used.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

30. For the period from the summer of 1979 to the present, we have reports of 43 separate chemical attacks with more than 3,000 chemical-associated deaths (see map, figure 4). Ten separate chemical attacks, killing considerable numbers of persons, were reported in the first three months of 1980. All of the reports came from northeastern Afghanistan and provide the highest percentage of reported deaths. By the spring and summer of 1980, chemical attacks were reported to have occurred in all areas of concentrated resistance activity. Reports of chemical weapon use in 1981 essentially parallel 1980 reporting with respect to frequency and location of attack. Of the 43 chemical attack reports, 36 have come from human sources, including Afghan Army deserters, Mujahedin resistance fighters, journalists, and US physicians. For 24 of the reported 43 attacks we have additional independent evidence supporting allegations of chemical attacks.

[redacted]

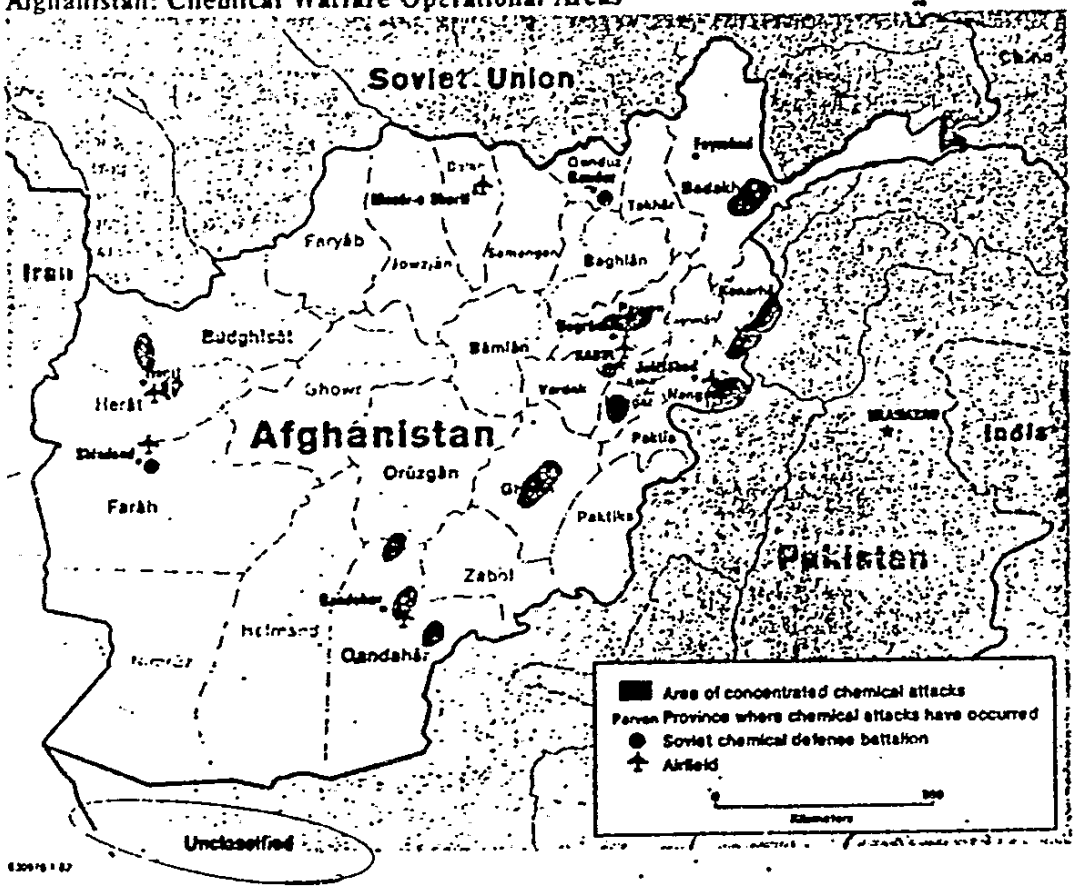
35. Victims of Soviet attacks, conducted to flush them from caves, describe symptoms that cannot be associated with riot control agents like CN and CS or even Adamsite. Medical examinations of some of the victims include reports of paralysis, other neurological effects, blisters, bleeding, and sometimes death. While none of the agents being used in Afghanistan have been positively identified through sample analysis, it seems clear that the agents being used are far more toxic than the irritants cited above. (U)

[redacted]

[redacted]

[redacted]

Figure 4
Afghanistan: Chemical Warfare Operational Areas



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[redacted]

What Chemical Agents Are Being Used?

39. The specific chemical agents being used in Laos, Kampuchea, and Afghanistan cannot be determined without collection and analysis of at least one of the following: environmental samples contaminated with agent, the munitions used to deliver agents, or biological specimens from victims of an attack. A study by medical-toxicological experts of symptoms exhibited by individuals exposed to toxic agents does provide a good indication of the general class of chemical agent used. Thus, the range of clinical manifestations from chemical agents as reported by a US Army investigative team resulted in the determination that nerve agents, irritants such as CS, and a highly toxic hemorrhaging chemical or mixture of chemicals were used in Laos. Other medical-toxicological personnel arrived at the same determination and further indicated that toxins such as the trichothecenes were a probable cause of the lethal hemorrhaging effect seen in Kampuchea as well as Laos. Symptoms reported by the DK in Kampuchea and the Mujahedin in Afghanistan were in many cases similar to those reported by the H'Mong in Laos. In addition, symptoms reported from Afghanistan and Kampuchea indicated that a highly potent, rapid-acting incapacitant "knockout" chemical also was being used. Mujahedin victims and witnesses to chemical attacks reported other unusual symptoms, including a blackening of the skin, severe skin irritation with multiple small blisters and severe itching, severe eye irritation, and difficulty in breathing—suggesting that phosgene oxime or a similar substance was used. (U)

40. Collecting samples possibly contaminated with a toxic agent during or after a chemical assault is difficult under all circumstances but particularly when the assault is against ill-prepared people without gas masks and other protective equipment. Obtaining contaminated samples that will yield positive traces of specific chemical agents is dependent on a number of factors. These include the persistency of the chemical, the ambient temperature, rainfall, wind conditions, the media on which the chemical was deposited, and the time, care, and packaging of the sample from collection to analysis in a laboratory. Many standard chemical warfare agents are nonpersistent and disappear from the environment within a few minutes to

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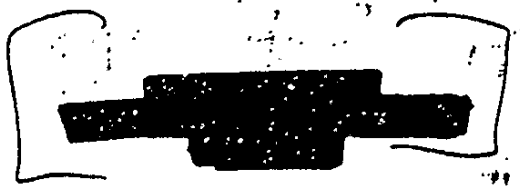


several hours after being dispersed. These include, for example, the nerve agents sarin and tabun; the blood agents hydrogen cyanide and cyanogen chloride; the choking agents phosgene and diphosgene; and the urticant phosgene oxime. Other standard CW agents—such as the nerve agents VX and thickened soman and the blistering agents sulfur mustard, nitrogen mustard, and lewisite—may persist for several days to weeks depending on weather conditions. The trichothecene toxins have good persistency but may be diluted to below detectable concentrations by adverse weather conditions. To maximize the chances of detection, sample collections should be made as rapidly after a chemical assault as possible, and with many agents this means minutes to hours. Under the circumstances of Southeast Asia and Afghanistan this has simply not been possible. While numerous samples were collected, few of them held any realistic prospect of yielding positive results. It is fortunate that trichothecenes are sufficiently persistent to allow detection several months after the attack. (U)

41. Samples have been collected from Southeast Asia since mid-1979 and from Afghanistan since May 1980. To date about 50 individual samples—of greatly varying types and usefulness for analytical purposes—have been collected and analyzed for the presence of traditional CW agents, none of which have been detected. On the basis of recommendations by medical and toxicological experts and of findings by the CSL, many of the samples have been analyzed for the trichothecene group of mycotoxins. Four samples, two from Kampuchea and two from Laos, were found to contain high levels of trichothecene toxins. Preliminary results of several additional samples indicate the presence of trichothecenes or their metabolites, but quantification of their levels is pending. Details concerning the samples, including the circumstances of their collection, the analysis, and the results, are provided in volume II, annex B. (U)

42. The accompanying table lists the chemicals and their probability of use in Afghanistan by Soviet and, in Southeast Asia, by Vietnamese and Laotian forces. The judgments shown in this table are based on sample analysis, on collateral and special intelligence, and on medical and toxicological evaluations. (U)

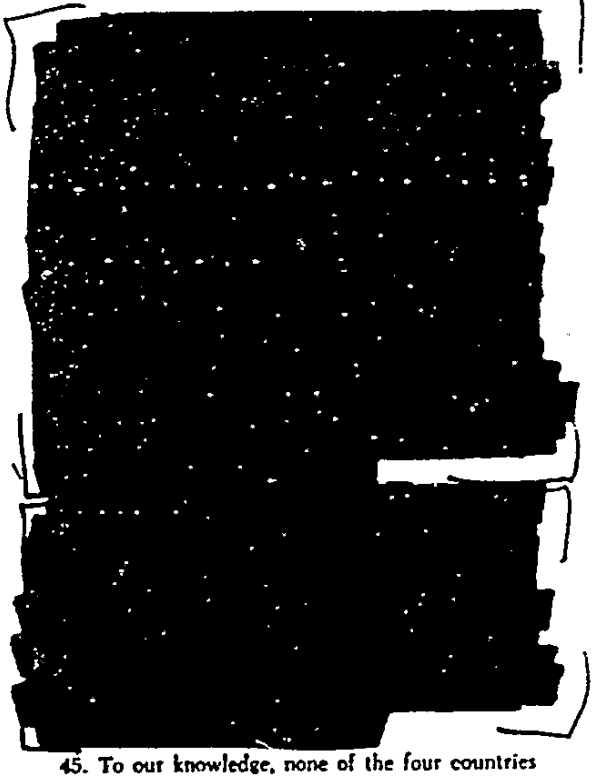
Degrees of Confidence in Identification of Specific Classes of Chemicals Used in Southeast Asia and Afghanistan*

	Laos	Kampuchea	Afghanistan
Trichothecene toxins	Confirmed	Confirmed	Suspected
Nerve agents	Probable	Probable	Probable
Irritants	Probable	Probable	Probable
Vesicants and urticants	Suspected	Suspected	Probable
Incapacitants	Suspected	Probable	Probable

* The confidence levels shown refer to the identification of specific chemicals used, not to the probability that some form of lethal chemical was used. We consider the latter a certainty.

This table is unclassified.

Soviet Chemical Warfare Activities



45. To our knowledge, none of the four countries most recently involved with CW activities—Vietnam, Laos, Kampuchea, and Afghanistan—has any large-

[redacted]

scale facility or organization for the manufacture of chemical and biological materials. Nor are they known to have produced even small quantities of chemical warfare agents or munitions. The technical problems of producing large quantities of weapons-grade toxin, however, are not so great as to prevent any of the four countries from learning to manufacture, purify, and weaponize these materials. It is highly unlikely, however, that they could master these functions without acquiring outside technical know-how. The only country known to be providing chemical warfare assistance to these countries is the Soviet Union. (U)

46. The Soviets have had advisers and technicians working in Vietnam, Laos, and Kampuchea for many years, but not until early 1979 did evidence connect the Soviet military directly with chemical warfare activities. The evidence is quite conclusive [redacted]

[redacted]

The Yemen Experience

48. Additional evidence that the Soviets are prepared to supply toxins and other lethal agents to client states is provided by the Yemen case, which is reassessed in volume II, chapter VI, and summarized here (U)

[redacted]

50. In January 1967 a new agent or combination of agents was dispersed by Soviet-made IL-28 light bombers. The agent was remarkable for its extremely rapid and devastating effect on humans, animals, and vegetation. This material was not identified conclusively either. A British officer claims that he clearly identified as a Soviet the dead pilot of a plane shot down after dropping chemical bombs (U)

51. There are striking similarities between the symptoms described as resulting from the attacks in 1967 and those that have been reported from Southeast Asia and Afghanistan. We cannot positively state that trichothecene toxins were used by the Soviets in Yemen, but that explanation fits the evidence better than any other. Samples that were collected by reputable sources did not reveal any known chemical warfare agents. At that time toxins were not suspected and the special analytic techniques that revealed trichothecene toxins in 1981 were not developed in 1967 (U)

52. There is also a striking similarity between the tactics used in Afghanistan in 1979 and Yemen in 1967 against resistance forces operating from sanctuaries in rugged terrain. The use of the IL-28 bombers in both places is particularly striking [redacted]

[redacted]

[redacted]

CONCLUSIONS

Laos. We conclude from all the evidence that selected Lao and Vietnamese forces, under direct Soviet supervision, have employed lethal trichothecene toxins and other combinations of chemical agents against the H'Mong resistance forces, including their villages, since at least 1976. Thousands have died, have been severely injured, or were driven from their homeland by the use of these agents. (U)

Kampuchea. The evidence strongly supports the conclusion that the Vietnamese have similarly been using lethal trichothecene toxins and other combinations of chemical warfare agents on Democratic Kampuchean forces and other resistance groups since at least 1978. (U)

Afghanistan. We conclude that Soviet forces in Afghanistan have used a wide variety of lethal and nonlethal chemical agents on Mujahedin resistance forces and Afghan villages since the Soviet invasion in December 1979. Afghan Government forces probably used chemical weapons before the Soviet invasion, but we cannot identify the types of agents used.

[redacted]

[redacted]

[redacted]

[redacted]

Motivation for Chemical Weapon Use

[redacted] consider the question of motivation. Is there a military-strategic or tactical rationale for the systematic use of chemical weapons in Laos, Kampuchea, Afghanistan, and Yemen? We conclude that the military problems faced in all four countries—as viewed from the perspective of the Soviets and their allies—make the use of chemical weapons a militarily effective way of breaking the will and resistance of stubborn guerrilla forces operating from relatively inaccessible protected sanctuaries. These weapons offer substantial advantages over conventional weapons. In all four countries the resistance was able through conventional means to frustrate Soviet and client-state objectives of extending and consolidating control over the countries attacked. The Soviets probably reasoned that attainment of these objectives—as quickly and cheaply as possible—justified use of chemical weapons and outweighed a small risk of exposure and international condemnation. They may well have calculated that they and their allies could successfully counter or deny charges that chemical weapons had been used, recognizing that it would be as difficult to compile incontrovertible evidence from Southeast Asia and Afghanistan as it was from Yemen in the 1960s. In addition, the Soviet military very likely consider these

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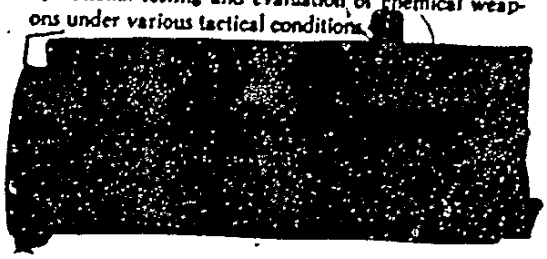
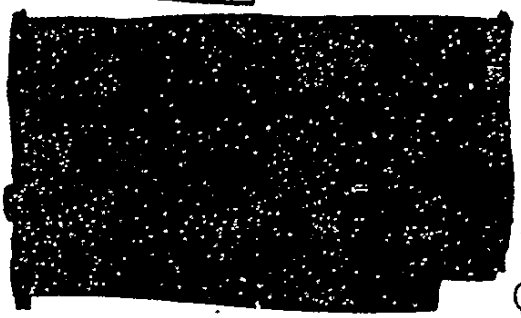
remote areas as providing unique opportunities for the operational testing and evaluation of chemical weapons under various tactical conditions.





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IMPLICATIONS

In volume II, chapter III, we consider and reject a number of alternative explanations for the phenomena observed. One hypothesis best fits all the evidence: *the Soviets had begun to weaponize toxins by at least the early 1960s and have used these weapons in Laos and Kampuchea, and possibly in Yemen and Afghanistan.*

[redacted]

[redacted] Indeed, the Soviet military consider the employment of chemical weapons by their forces and those of their allies to be an acceptable and effective means of suppressing resistance even in local wars.

As a result, countries like Thailand, Pakistan, and China may develop an even greater sense of alarm in contemplating conflict with the Soviet Union or its allies. Chinese experts are actively reanalyzing their evidence on Vietnamese use of chemical agents against their forces in 1979. Beyond these considerations, there is growing international concern that lethal chemical weapons may become an accepted method of limited warfare in conflicts throughout the Third World.

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Use of Toxins and Other Lethal Chemicals in Southeast Asia and Afghanistan

Special National Intelligence Estimate
Volume II—Supporting Analysis

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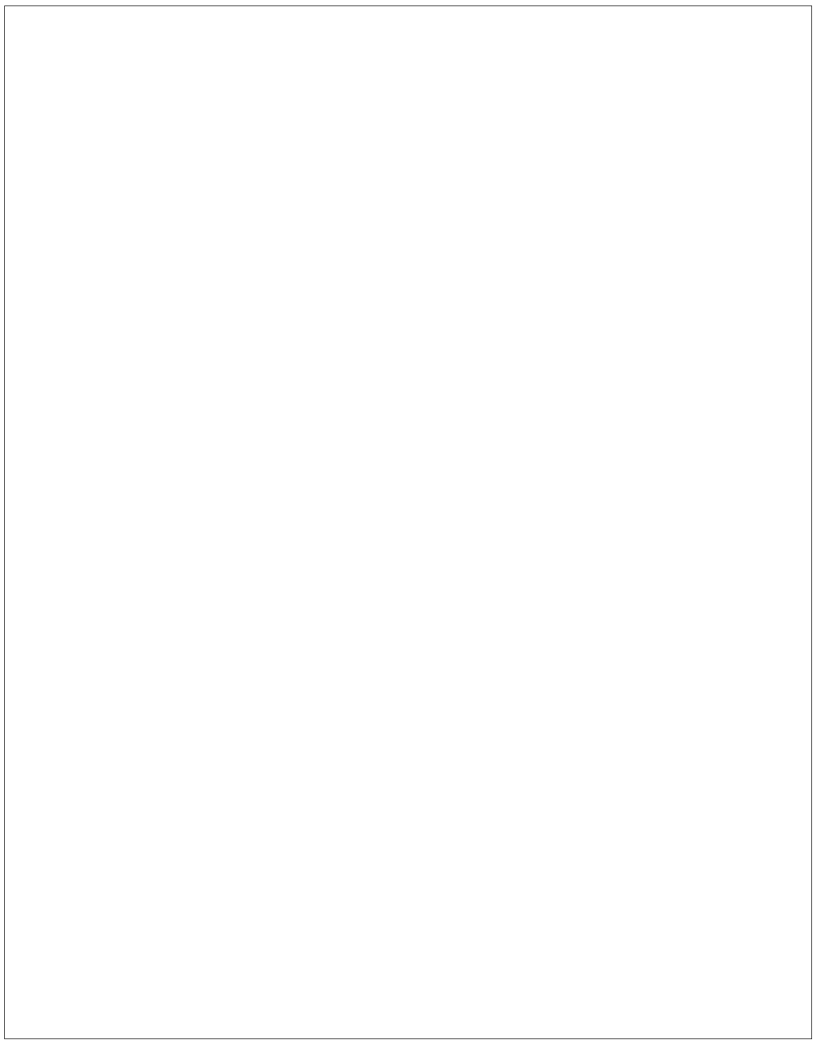

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USE OF TOXINS AND OTHER LETHAL CHEMICALS IN SOUTHEAST ASIA AND AFGHANISTAN

Volume II—Supporting Analysis

The National Foreign Intelligence Board
approved publication of this Estimate
on 2 February 1982.

Information available as of 26 February 1982
was used in the preparation of this second volume.

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THE NATIONAL FOREIGN INTELLIGENCE BOARD CONCURS.

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Also Participating:

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I. CHEMICAL WARFARE IN LAOS

Key Judgment: Lao and Vietnamese forces, assisted by Soviet logistics and supervision, have used lethal chemical agents against H'Mong resistance forces and villages, causing thousands of deaths since at least 1976. Trichothecene toxins have been positively identified as one of the classes of agents used, but medical symptoms indicate that irritants, incapacitants, and nerve agents also have been employed. (U)

Nature of the Evidence

1. Since 1976 a total of 261 chemical attacks against H'Mong villages and guerrilla strongholds in Laos have been reported by victims and witnesses. These attacks reportedly caused the deaths of at least 6,504 of the H'Mong people.[1] Most of the reports were provided by H'Mong refugees, including village leaders, who were interviewed in Thailand and the United States. These more than 200 interviews were carried out variously by US Embassy officials in Thailand, a Department of Defense team of medical-toxicological experts,[2] US physicians (including a forensic medicine specialist), Thai officials, journalists, and representatives of international organizations. According to these interviews, US L-19 and T-41 aircraft—captured during the US-Vietnamese conflict—and Soviet AN-2 aircraft were usually employed to disseminate toxic chemical agents by sprays, rockets, and bombs. In some cases, Soviet helicopters and jet aircraft were said to have been used. (U)

2. The medical symptoms reportedly produced by the chemical agents are varied. According to knowledgeable physicians, the symptoms clearly point to at least three types of chemical agents: incapacitant/riot control agents, nerve agent(s), and one or more agents causing massive hemorrhaging. The last-named were positively identified as trichothecene toxins in the fall of 1981. (U)

3. Important testimony was also provided by Laotian and Vietnamese defectors. A number of governments provided information based on their own collection efforts. Information provided by these sources includes the following:

- A special Laotian Air Force unit was responsible for carrying out attacks using chemical warfare (CW) rockets.
- CW agents were stored at sites in Laos.
- Warheads containing lethal agents were fitted to US rockets in several small laboratories in Laos.
- A nerve agent was used.
- Laotian and Vietnamese forces exterminated some H'Mong people by herding them into a cave, closing the entrance, and filling the cave with a lethal chemical gas. (b)(1)
- The Soviets were involved in an advisory and supply role. (U)

4. (b)(1) (b)(3) confirmed the presence, transportation, and use of chemical warfare agents in Laos. The existence there of CW storage facilities was first noted on 14 February 1979, when the LPLA headquarters at Vientiane made preparations for Soviet personnel to inspect a chemical facility at Pakxe, where lethal chemical agents were stored. Other reports indicate that sites used for this storage of chemical agents or munitions exist at Savannakhet, Xiangkhoang, Vieng Sai, and Xeno. Chemical agents and munitions are moved by truck and aircraft between storage sites and airfields for loading on aircraft used in mounting chemical assaults. (b)(1) (b)(3)

5. (b)(1) (b)(3) typical conventional ammunition storage facilities, which are also used to store chemical munitions, are located near Pakxe, Xiangkhoang, and Vientiane. (b)(1) (b)(3)

(b)(3)

[1] See annex A.
[2] See annex C.

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6. Soviet AN-2 aircraft and captured US L-19, T-41, and T-28 aircraft. These have been the most commonly identified chemical assault aircraft in Laos.

7. ***Sample Collection and Analysis.*** In October 1979 a program was initiated to collect and analyze environmental samples that might contain residue from a chemical attack and tissue samples from H'Mong refugees reportedly exposed to toxic chemicals.[3] Environmental samples received from areas of chemical attack include: a piece of polyethylene plastic believed to have been contaminated with a vesicant and six samples containing a yellowish powder residue recovered from rocks, leaves, and roof thatching.

8. Analysis failed to reveal the presence of a vesicant or any known CW agent on the plastic sample. The powder residue samples were analyzed for indication of any known standard CW agents. None were detected in these samples. Two of the samples, however, contained diacetoxyscirpenol (DAS), a potent toxin of the trichothecene group, which causes massive hemorrhaging and death. One of these also contained T-2 toxin.[4]

9. ***Medical Examinations.***[5] A continuing problem has been the compilation of medical records and clinical histories on victims exposed to chemical attacks. This has been especially true in the camps through which H'Mong refugees are staged before resettlement to other countries. At least three, probably more, physicians who have been camp medical directors report that numerous refugees did show signs of continued gastrointestinal hemorrhaging, small blisters, and respiratory signs not associated with known pulmonary diseases even after exhaustive diagnostic tests. All these individuals reported involvement in at least one direct chemical attack of "yellow rain," and several of them were near death. These reports cover primarily the period 1978 through mid-1980. (b)(1) (b)(3) (b)(3)

10. Since the relief organizations in the camps do not routinely maintain medical records on patients, preferring to run simple outpatient centers, the medical data were collected by the camp medical directors or nurses and maintained separately in clinic files. In all cases, the files mysteriously vanished shortly before visits by official interviewers, most recently prior to the visits of the UN group of experts investigating CW use. (b)(1) (b)(3) (b)(3) (b)(3)

The Evidence

11. Vietnamese and Laotian chemical attacks against the H'Mong villages in northern Laos date back at least to 1976, when refugees first reported such attacks to officials in the Thai camps. (See figure 5.) Other than refugee reports, however, very little evidence on chemical attacks appears to have been compiled between 1976 and early 1979. From 1979 on, a much wider range of information broadly supporting the H'Mong allegations was obtained. (b)(3) (b)(3)

12. ***Lao Pilot's Testimony.*** The most complete description of the period 1976-78 came from a Lao pilot who was directly involved in chemical warfare. The pilot, a former LPLA officer who defected in 1979, reported that he flew L-19 and T-41 aircraft equipped to dispense toxic chemical agents on H'Mong villagers in the Phou Bia area of northern Laos. He said that the LPLA, in cooperation with the PAVN, had conducted CW operations in Laos since April or early May 1976. At that time, two LPLA H-34 helicopters were flown between Long Tieng and the Phongsavan airfield (near Xiangkhoang), both in Xiangkhoang Province, on a series of flights to transport rockets to Phongsavan for storage. (b)(3) (b)(3)

13. Between June and August 1976 the LPLA launched attacks in the area of Bouamlong—in Xiangkhoang Province—that was a stronghold for remnants of the forces of former H'Mong General Vang Pao. The LPLA used L-19 aircraft for CW rocket attacks aimed at eliminating the H'Mong resistance in that area. LPLA crews responsible for loading (b)(3) (b)(3)

[3] See annex B, table B-1, for a tabulation of samples collected and analyzed.

[4] See annex D.

[5] See annex E.

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rockets on the attack aircraft noted, however, that they were not allowed to use the rockets that had been moved from Long Tieng to Phongsavan, even though Phongsavan was much closer to the Bouamlong target area than Long Tieng, where LPLA aircraft had to rearm. The pilot said that during nearly three months of flying missions against the Bouamlong area, he flew his L-19 aircraft to Long Tieng to be armed with rockets.

14. In late 1976 the pilot's L-19 aircraft was rearmed with rockets stored at Phongsavan. Initially, H-34 helicopters were used to transport the rockets from Phongsavan to a depot near the Ban Xon airfield, Vientiane Province, where they were fitted onto racks of the L-19 aircraft for missions in the Phou Bia area. Later, the rockets from Phongsavan were transported to Ban Xon by trucks. All US-manufactured rockets were stored with the tip and canister kept apart; in other words, the two parts had to be joined before being fitted to the racks on the aircraft. The pilot observed, however, that all the rockets transported from Phongsavan to Ban Xon were already assembled.

15. As part of his routine flight activities, the pilot would check over his aircraft and, in doing so, examine the tip portion of new smoke rockets that had been transported from Phongsavan. He said that most of them appeared "loose" in the portion where the tip and canister joined, whereas the tip and canister of the ordinary explosive-type rockets at Long Tieng were noticeably more tightly connected.

16. In late 1976, in preparation for airstrikes on Kasy (Louangphrabang Province) and in new areas of Phou Bia, the pilot said he began carrying two or three PAVN staff officers, sometimes accompanied by an LPLA staff officer, in T-41 aircraft for reconnaissance over the target areas. When these airstrikes were launched, the defector pilot initially flew his L-19 aircraft on missions with another pilot and an LPLA staff officer sitting in the rear seat. After two or three weeks, however, PAVN staff officers, who spoke excellent Lao, began alternating in the rear-seat role with the LPLA officers. Before each mission, the PAVN or LPLA staff officer would go over target areas outlined on situation maps—which then were taken along—and would point out the targets to be attacked. The source noted that at no time did the PAVN staff officer sitting in the back seat of his aircraft communicate with LPLA officers on the ground, as did the LPLA staff officers. A new PAVN officer was used on each mission of the T-41 reconnaissance and L-19 airstrike missions in the H'Mong areas. The average age of these PAVN staff officers was in the middle forties.

(b)(3)
(b)(3)

17. The source related that before flying L-19 airstrike missions with a full load of rockets he was often warned by an LPLA commander to fly at above-normal altitudes when firing rockets to preclude hazard to the occupants of the aircraft. For this reason the pilot surmised that the "smoke" rockets fired at the H'Mong people were unusual. He was able to observe that the "smoke" rockets detonated in the air and that some produced white smoke with a mixture of blue, while others produced red smoke with a mixture of yellow. The ordinary, explosive-type rockets detonated on impact. The commander or his designated representative told the pilot before every mission that the operations—called Extinct Destruction Operations—were intended to "wipe out" the reactionary H'Mong people.

(b)(3)
(b)(3)

18. Before a mission involving "smoke rockets," the commander warned the pilots to keep the operation secret. The source said that, during the nearly two years in which he flew rocket missions, he learned from the LPLA staff officers accompanying him that there were two types of rockets. The first, mostly "smoke" rockets, were to be fired at targets far away from LPLA and PAVN troops to avoid exposing them to the poison smoke. The second was of the ordinary explosive type, considered a "close support" rocket that could be fired near LPLA and/or PAVN troop positions. Initially, the L-19 aircraft carried eight rockets—five "close support" and three "smoke" rockets. Later, only four rockets, mainly of the "smoke" type, were carried.

(b)(3)

(b)(3)

19. After each mission in which chemical warfare rockets were used, the pilot was returned to a "rest house" at Phongsavan, where an LPLA doctor and nurse would examine him. He said that after his missions, especially in 1978, he was particularly well treated by the examining doctor and watched very closely by the LPLA nurse. Those L-19 aircraft pilots

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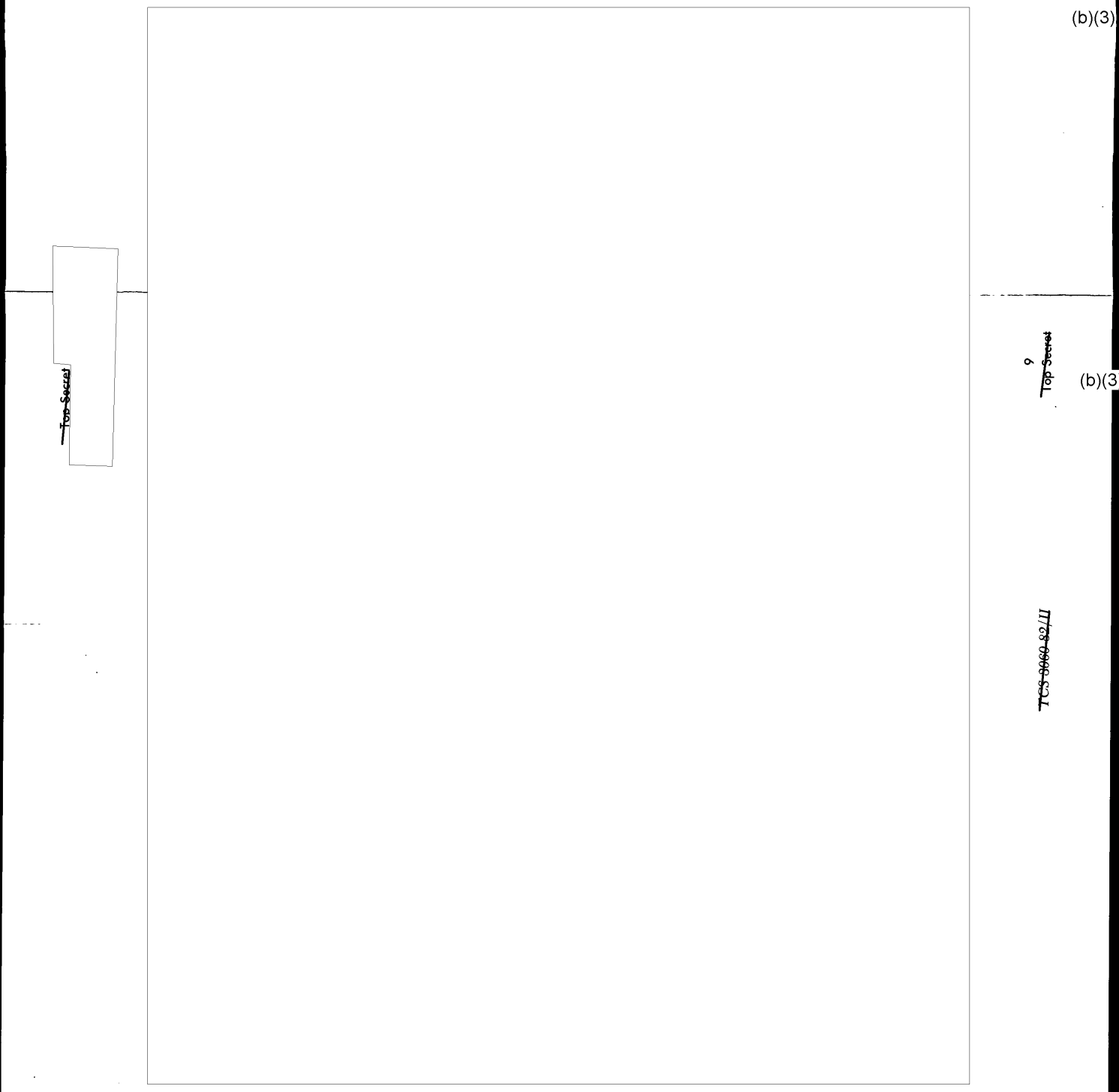

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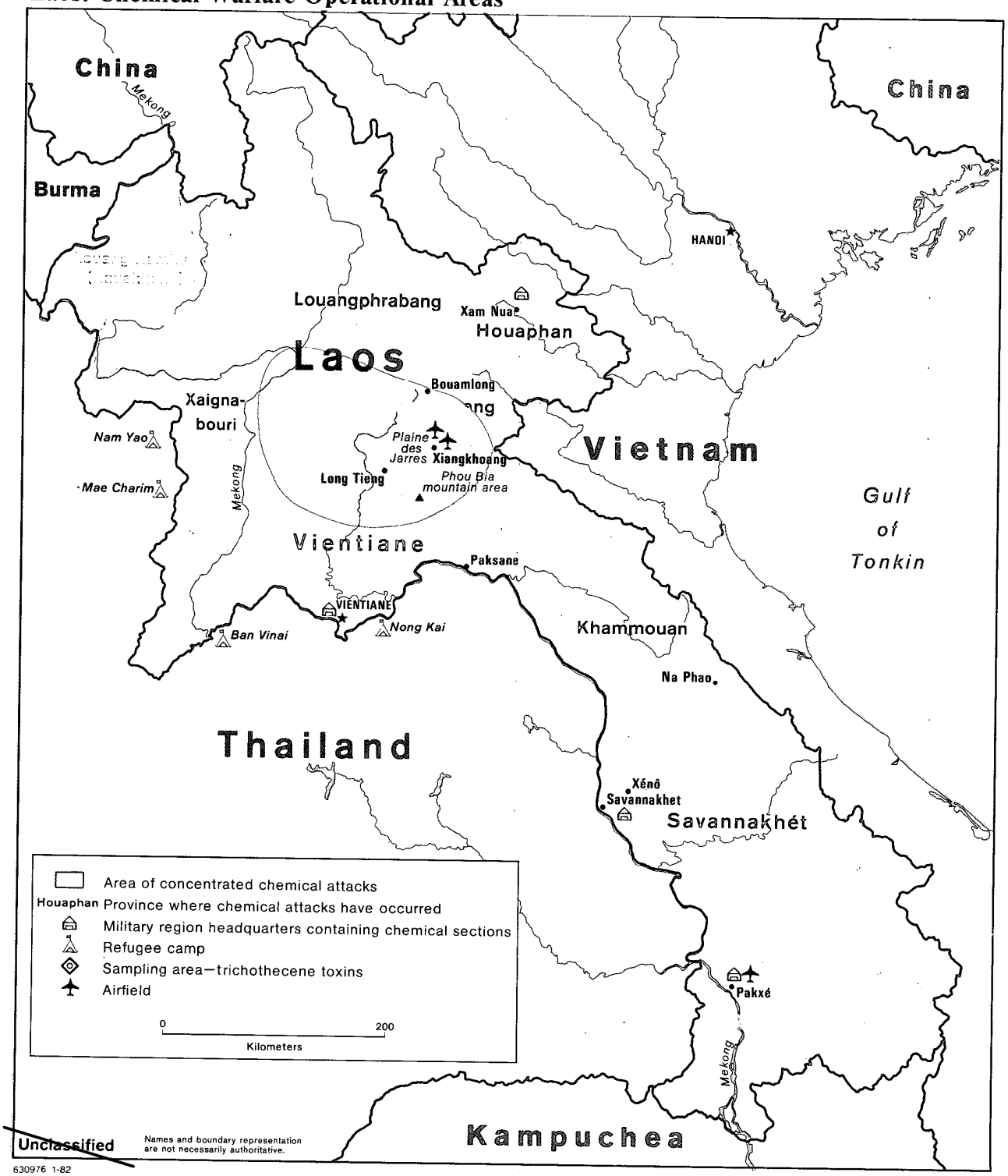
Figure 5
Laos: Chemical Warfare Operational Areas



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assigned to missions utilizing chemical warfare rockets had special privileges, including additional flight pay and free meals at the Phongsavan cafeteria. In October 1978 the LPLA stopped using L-19 aircraft on combat missions and began using Soviet MIG-21s for chemical attacks on the Phou Bia areas.

20. ***Corroborating Evidence.*** Several H'Mong reports provide significant substantiation of the testimony of the Lao pilot. The chief of eight villages, for example, described attacks covering all seven days of the week of 5 June 1976 in the Bouamlong area, Xiangkhoang Province. He described L-19 aircraft firing rockets that produced red and green smoke. Ten villagers were killed by gas and 30 by shrapnel. Most of the H'Mong reports documented by a US foreign service officer in June 1979 and a Department of Defense medical team in October 1979 are consistent with the Lao pilot's testimony. H'Mong observers familiar with military aircraft reported L-19s until late 1978. After that time, reports described jets or "MIGs" and some accurately described Soviet AN-2s.

21.

As is discussed in chapter III, the Soviets supervise the chemical warfare activities in Laos; we assume, therefore, that chemical munitions are handled in about the same manner as in the USSR. No protective clothing or special decontamination equipment is required for loading chemical bombs on aircraft and helicopters at chemical munitions test ranges, according to former Soviet chemical warfare personnel.

22. The Lao pilot's description of the rockets used on the L-19 was corroborated by other sources. A H'Mong refugee, a former commmander of a 500-man resistance force, reported that in 1977 he found a rocket canister and a separated warhead that he believed were the kinds used by the Vietnamese and Lao. The canister, he said, had authentic US markings identifying it as a US-manufactured 2.75-inch rocket, as well as three lines of Russian writing (which he could not translate). Another H'Mong resistance force officer, who reportedly had been trained as a liaison officer and ordnance expert before the Communist takeover of Laos, stated that he too believed the rocket canister was of US manufacture and that the Soviet technicians in Laos had modified the upper stage to contain a poisonous (lethal) chemical. (b)(3) (b)(3)

23. The diameter of the warhead was reported to be 12.5 centimeters (5 inches), probably a measurement taken on a modified warhead because the United States does not have a 5-inch warhead for the 2.75-inch "rocket motor." During the Vietnam conflict, about 35 million US-manufactured 2.75-inch rockets were sent to the war zone, and many tens of thousands of these no doubt fell into North Vietnamese hands when South Vietnamese forces collapsed. The usual US fills for these rockets were white phosphorus, high explosives, flechettes, and some CS (riot control agent). The Vietnamese may be using some of these rockets with existing loads, but modified warheads for the 2.75-inch rocket motor could easily be fabricated in Vietnam and filled with a lethal or nonlethal agent in Laos, especially with Soviet assistance. According to US experts, fabrication of a warhead 5 inches in diameter, necked down to fit the 2.75-inch rocket, could be accomplished by trained technicians in a small, well-equipped machine shop and laboratory. (U) (b)(3) (b)(1) (b)(3)

24. ***Other Evidence.*** (b)(1) (b)(3)

learned that a special Laotian Air Force unit is responsible for chemical rockets. This unit is commanded by a Soviet-trained Lao and has a Soviet rocket expert attached as an adviser. Modification of captured US-manufactured 2.75-inch rockets to contain lethal CW agents reportedly is done routinely in Laos, with chemical agents supplied by the Soviets under the direction of Soviet and Vietnamese experts. Small, but adequately equipped three- and four-man facilities for this activity reportedly are located in Vientiane, at Phongsavan in Xiangkhoang Province, and in Savannakhet Province. (S NF REL UK CAN AUS NZ NC) (b)(1) (b)(3)

25. information provides a picture of the Laotian chemical warfare organization (b)(1)

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and the direct involvement of the Vietnamese and the Soviets in supporting that effort. The Supreme Headquarters Command in Vientiane controls the Regional Military Chemical Sections.

26. In the fall of 1981 the United States discovered trichothecene toxins on a vegetation sample collected from Kampuchea. This led to a reanalysis of samples taken from Laos since 1979. Two samples of a yellow substance collected from different areas showed high levels of trichothecene toxins. New samples were received in late 1981 and are currently being analyzed.

27. The discovery of trichothecene toxin as the mysterious lethal agent that eluded US analysts for many years has somewhat overshadowed a significant body of earlier evidence that several different types of agents—lethal and incapacitating—have been used over the years.

28. There is even some evidence to suggest that in the early years the Laotian and Vietnamese forces were experimenting with different agents and delivery systems in search of an effective way to exterminate the H'Mong or drive them out of Laos.

29. A Pathet Lao soldier is reported to have told H'Mong villagers in early 1978 that an agent sprayed over their villages as a test had not been effective but that he could provide them an antidote if they were affected by the agent. Dispersal of this particular agent was associated with a "black rain." When it was effective, the symptoms were quite different from what has been described after "yellow rain" attacks. Drops on bare skin caused severe necrosis, rotting skin, and high fever that sometimes resulted in death.

30. In a number of the refugee reports, the eyewitness accounts describe the "red gas" as being more lethal than the "yellow cloud." A former Lao Army captain stated that the "red gas" caused the H'Mong to die within 12 hours. An employee of an international organization interviewed victims of a 15 September 1979 attack where nonlethal rounds preceded an attack by five or six "red gas" bombs that covered a 500-meter area. Persons within 30 to 100 meters of the circle died in 10 minutes after severe convulsions. Others had headaches, chest pains, and vomiting but did not die.

31. While it has been difficult to associate specific symptoms with the colors, it is apparent in reviewing reports back to 1976 that several different agents have been used. The different colors cannot be dismissed as only smokes used to mark target areas. In many cases it appears that irritants or incapacitants have been used on H'Mong villages before use of a lethal or heavy-casualty-producing agent like nerve gas or toxin. (b)(1) (b)(3) (b)(3)

32. The method of dispersing agents also varies. Several types of aircraft and helicopters have been used. There have been questions raised about the effectiveness of agent delivery at the high altitudes reported (7,000 to 10,000 feet). Airburst rockets could be fired from high altitudes effectively. Many reports, however, including those from H'Mong soldiers, described attacks made at 1,000 to 3,000 feet. The Lao pilot described firing the chemical rockets from altitudes higher than would be normal for conventional rockets. A number of reports, especially from 1977 and 1978, describe chemical attacks by 105-mm artillery and 122-mm rockets. One report from a H'Mong officer described 122-mm chemical rocket attacks from Louangphrabang Airfield on a village 8 to 9 kilometers away. (b)(3) (b)(3) (b)(3) (b)(3)

33. (b)(1) (b)(3)

a Lao military report confirmed that poison chemicals had been dispersed by the Lao Government in an effort to kill Lao hill tribesmen. (b)(1)

confirmed that toxic chemicals had been spread and described small yellow grains. (b)(3)(3)

a hospital at Paksane requested assistance in treating a large number of villagers suffering from nausea and bloody diarrhea. (b)(1) (b)(3)

reports revealed that Lao military units were setting up classes in the use of chemical weapons and protection from their use by the "enemy." One report stated that "enemy forces" entered Laos from Thailand with liquid toxic chemicals to poison Lao units' food and water. (TS U) (b)(1) (b)(3)

34. (b)(1)

reports suggest the not surprising fact that the chemical warfare program is compartmented within the Lao military, and that field units (b)(3)3)

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are now acquiring knowledge about chemical warfare activities previously restricted to specialized units and individuals. This accords with the secretive nature of the Vietnamese-directed chemical activity reported by the Lao pilot. Lao troops probably started receiving a heavy dose of propaganda about an enemy chemical threat in order to offset spreading knowledge of the government's use of lethal agents.

35. In a 15 December 1981 press conference in Beijing, a former Lao Health Ministry Bureau Director, Khamsengkeo Sengsthith, said that the Vietnamese were using chemical weapons "in the air and on the ground" in Laos, killing "thousands." He said the Vietnamese alone were using chemical weapons, keeping the affairs secret from the Laotians. Furthermore, he stated that 3,000 Soviet advisers are in Laos and they "have taken control" of the Lao Air Force while 40,000 to 50,000 Vietnamese troops have reduced Laos to colony status. We believe that few people in the Laotian military and government are aware of the Vietnamese/Soviet-directed chemical warfare activities.

II. CHEMICAL WARFARE IN KAMPUCHEA

Key Judgment: Vietnamese forces have used lethal trichothecene toxins on Democratic Kampuchean troops and Khmer villages since at least 1978. Again, medical symptoms indicate that irritants, incapacitants, nerve agents, and a highly effective hemorrhagic agent or mixture of agents also have been used.

Nature of the Evidence

36. Since October 1978, radiobroadcasts, press releases, and official protests to the United Nations by the leadership of the Democratic Kampuchea (DK) dissident group have accused the Vietnamese and the Hanoi-backed People's Republic of Kampuchea (PRK) regime of using Soviet-made lethal chemical agents and weapons against DK guerrilla forces and civilians.

In November 1979, however, the guerrilla forces of the Khmer People's National Liberation Front reported that the Vietnamese had attacked them with a tear gas which, from their description, resembled CS. Subsequently, Thai officials, DK informants and refugees, defectors from the People's Army of Vietnam (PAVN), US and Thai medical personnel, officials of the International Committee of the Red Cross (ICRC), and Canadian and West European officials also have implicated the Vietnamese in the offensive use of lethal and incapacitating chemical agents in Kampuchea. (b)(1) (b)(3)

37. The conflict in Kampuchea differs from that in Laos in that the UN-recognized government of Kampuchea, Pol Pot's Democratic Kampuchea group, is operating as an organized guerrilla force. DK reports cannot be taken at face value. Pol Pot's forces are engaged in a propaganda effort against the Vietnamese, and many of their reports must be assumed to be false or grossly exaggerated. (b)(1) (b)(3)

According to DK officials, chemical attacks have occurred in 11 Kampuchean provinces and were concentrated in the provinces of Battambang and Pursat, along the Thai-Kampuchean border. (See figure 6.) The DK also accused the Vietnamese of poisoning food and medicines given to Kampuchean civilians. The Vietnamese have counterclaimed that the DK is poisoning Vietnamese food and water supplies with toxic plant extracts, including strychnine. (b)(3) (b)(1)

38. Official DK radiobroadcasts and press releases have stated that the PAVN-PRK chemical attacks produce symptoms ranging from mild, temporary incapacitation to severe incapacitation and death. Initially, in October 1978, the DK description indicated that a riot control chemical was used. The DK did not publicize symptomatic effects ascribed to lethal agents (as did reports from Laos) until the plight of the H'Mong refugees had been published in the Thai press and other news media. (b)(3) (b)(1) (b)(3) (b)(3)

39. The DK also reported that the Vietnamese were spreading a ground contaminant that produced severe swelling of the feet, tissue destruction, pus formation, and gangrene, with death occurring in one to three days. Because some Pol Pot forces do not wear shoes or sandals, a persistent vesicant or mixture of vesicants similar to the arsine and mustard class of compounds when used in this way could produce these effects. (b)(1) (b)(3) (b)(3)

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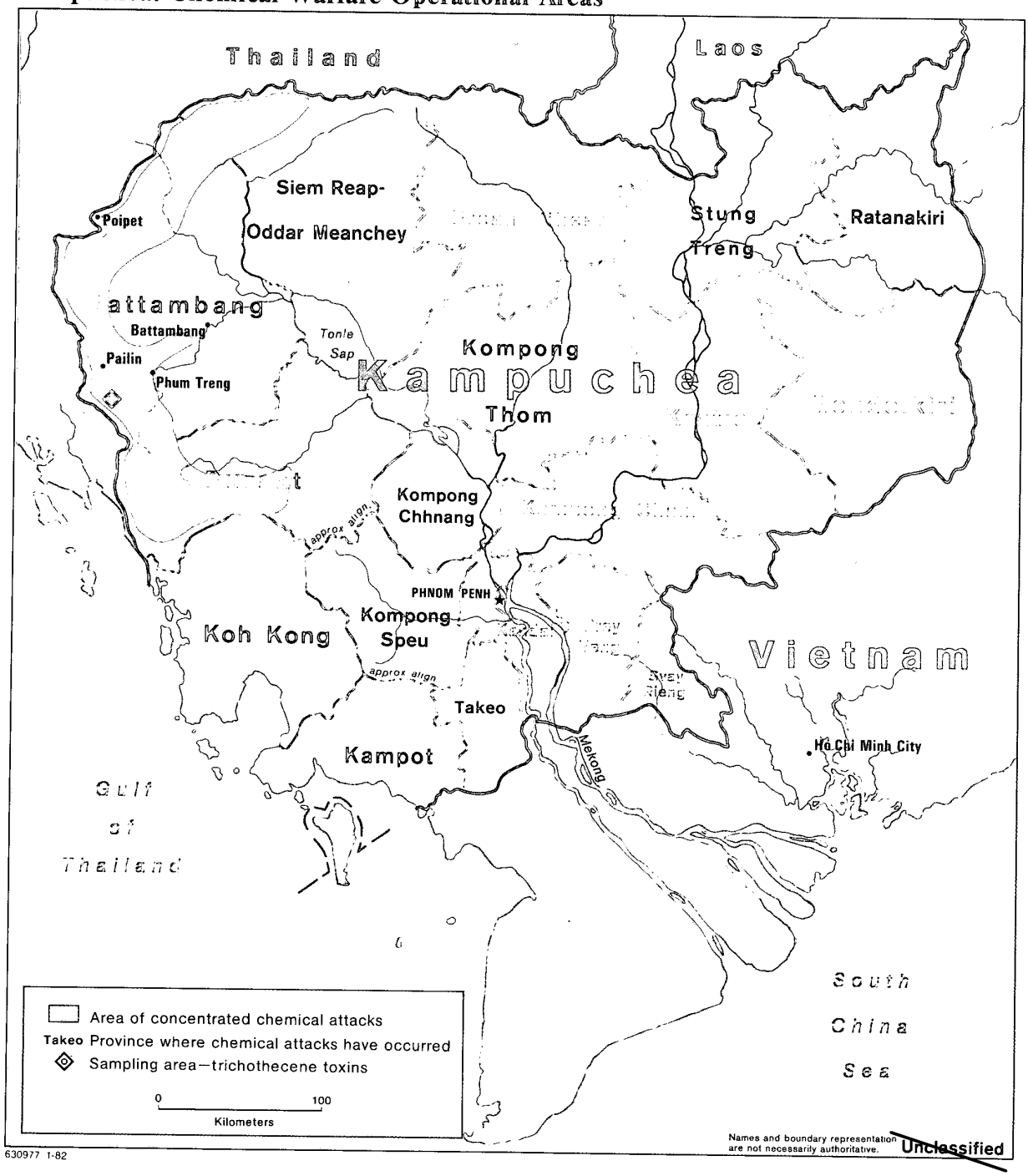
(b)(3)

Figure 6
Kampuchea: Chemical Warfare Operational Areas



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40. As early as August 1979, there were reports of the use in Kampuchea of lethal chemicals that caused vomiting, internal hemorrhaging, and death. Reporting by various sources, not directly connected with the DK, claimed that the PAVN and the PRK were attacking DK guerrillas with lethal and incapacitating chemicals delivered by artillery (60-mm and 120-mm), 107-mm rockets, M-79 grenade launchers, aerial sprays, rockets, and bombs. A total of 124 separate chemical attacks in which 981 individuals died have been reported since 1978.[6]

41. Aerial attacks reportedly were made with fixed-wing aircraft and helicopters spraying yellow and white aerosols that were usually lethal. Artillery chemical shells produced white and black smokes that were usually incapacitating. Liquid-type toxic chemicals reportedly were used in boobytraps. Lethal compounds allegedly were introduced into water supplies used by DK forces and refugees and into food and medicine given to Kampuchean civilians. PAVN deserters have reported Soviet involvement in transporting PAVN troops to forward areas and in firing chemical weapons, probably rockets, which exploded and emitted a deadly smoke.

42. reports that the Vietnamese have employed toxic chemicals against DK troops and civilians. According to reports, lethal and nonlethal chemicals were disseminated as a spray or smoke directly against DK forces and also were used to poison water supplies, food, and terrain along roads such as route 10 from Phum Treng to Pailin and along the Thai-Kampuchean border. Reporting indicates that anyone coming in contact with the apparently persistent chemical used on terrain bleeds through the skin, suffers congestion, vomits blood, and eventually dies from the effects. These symptoms are associated with trichothecene toxins. (TS U NF REL UK CAN AUS NZ OC)

43.

[6] See annex A.

44. (b)(1) (b)(3)
operations regiments of the 4th Infantry Division would receive protective equipment and training in its use. CW training exercises have been confirmed (b)(1) (b)(3)

45. a 17-vehicle convoy was transporting lethal and incapacitating chemicals to forward areas in Battambang and Siem Reap Provinces. (TS U NF REL UK CAN AUS NZ OC) (b)(1) (b)(3)

46. (b)(1) (b)(3)

47. ***Sample Collection and Analysis.*** A program to collect and analyze environmental samples possibly contaminated with CW agents was initiated in late 1979. Samples, reportedly from areas of chemical attack, include clothing reportedly taken from DK victims of a gas attack, an artillery shell casing, food (corn) samples, water samples, leaf samples, and human tissue. Background vegetation and water samples were also collected for baseline data.[7] (b)(3)

48. These samples were analyzed for standard known chemical warfare agents and the results were negative. Special analysis of water and vegetation samples showed the presence of mycotoxins of the trichothecene group.[8] (b)(3) (b)(1) (b)(3)(3)

49. ***Medical Examinations.*** DK victims of gas attacks have been interviewed by qualified medical personnel, including doctors, registered nurses, and trained medics from the United States, Thailand, and international organizations. Autopsies reportedly were performed on DK soldiers killed in the area attacked with trichothecene toxins.[9] (b)(1) (b)(3) (b)(3)

The Evidence

50. ***Indications Before 1980.*** There is no doubt that in 1978 and 1979 the Vietnamese and PRK forces made at least limited use of riot-control chemicals and possibly of incapacitating agents against both Communist and non-Communist guerrilla forces in Kampuchea. The chemicals used probably included screening (b)(1) (b)(3)

[7] See annex B. (b)(3)
[8] See annex D
[9] See annex E. (b)(3)

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smokes, riot-control agents such as CS, and an unidentified incapacitating agent that causes vertigo and nausea and ultimately renders victims unconscious.

51. DK officials attempted to provide the ICRC and international newsmen with substantive evidence that joint PAVN-PRK forces were using CW against DK forces. DK troops delivered to the ICRC blood specimens from alleged poison-gas victims. An independent laboratory under the direction of the ICRC reported the results of the analysis of the samples as being either indeterminate or negative. The ICRC also reported receiving a 60-mm shell containing a CW agent, but they have not released any analytical results. According to an ICRC representative in Bangkok, all physical evidence received by the ICRC on the use of CW in Kampuchea was sent to Geneva for analysis by independent laboratories. We have no reports of analysis of samples, other than that of blood specimens.

52. Several canisters have been discovered near the Thai-Kampuchean border which apparently contain nonlethal military chemicals. Smoke billowing from one of the canisters reportedly "numbed" one of the soldiers, who recovered after a brief hospitalization. DK troops found a gas grenade in an area that had been attacked by the PAVN. The reported description of and markings on this grenade fit those of a US CS grenade (ABC M-25A2), a weapon probably among US supplies captured by the Vietnamese. Vietnamese defectors have described chemical attacks using riot-control agents and incapacitants, and in some cases it appears that captured US stocks of CS riot-control agents were used. However, as previously stated, the United States did not have any type of lethal or incapacitating agents in Vietnam.

53. ***New Evidence in 1980 and 1981.*** In February 1980 the DK accused the Vietnamese of spraying poison gas in northwestern Battambang Province. Reporting indicated that the Vietnamese were using 60-mm mortars, 120-mm shells, 107-mm rockets, and M-79 grenade launchers filled with chemical agents as well as munitions delivered by T-28 aircraft.

54. information in February 1980 on 60-mm shells filled with agents that affected the blood and nerves. In late February the DK planned to exhibit poison victims to the ICRC in Bangkok and provide samples of blood and clothing, which in fact were sent to Geneva for analysis. (b)((b)(3)

(b)(3)

(b)(3)

55. According to the DK, the chemicals used were green and yellow, and powderlike in appearance. In some instances the gas was described as yellow or white. The symptoms described were tightening of the chest, disorientation, vomiting, bleeding from the nose and gums, discoloration of the body, and "stiffening of the teeth." In July 1980 the DK described artillery attacks that produced a black smoke causing itchy skin, weakness, skin lesions, and in some cases decaying skin and blisters. (U)

56. In mid-July, Vietnamese troops had stated that rocket propulsion systems were inside two large aluminum tanks being taken to the Phnom Var Mountains to be assembled with gas warheads for use on DK forces. (b)(1) (b)(3) (b)(3) (b)(1) (b)(3)

57. In December 1980, reporting revealed that the Vietnamese were once again firing chemical artillery shells, and it was believed that poison chemicals were being brought into the Thai border area. By March 1981 the DK had reported numerous attacks with lethal chemical agents and the poisoning of food and water. The DK reported planes that dropped a white or yellow powder, artillery fire that produced a white or black smoke, and a viscous material with the consistency of toothpaste that was put into cigarette packs left along trails and that emitted a lethal "gas." This "gas" caused instant death, whereas the "gas" from the planes caused a sequence of symptoms, including massive bleeding, rapid deterioration of the internal organs, and seepage of blood from the skin (b)(3) (b)(3) (b)(3)

58. In March 1981 a team trained to collect samples with special containers went into an area within hours after an attack and collected samples of vegetation and water. The team performed its own analysis on the samples, some of which, however, were turned over to US officials and eventually analyzed by the Army's Chemical Systems Laboratory. Later, one of the samples, a leaf and stem, was found to contain high levels of trichothecene toxins in an analysis performed at the (b)(3) (b)(1) (b)(3)

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University of Minnesota.[10] The symptoms described by the DK are consistent with those caused by the toxins found on the leaf sample. Furthermore, a US Government doctor was shown autopsy reports performed by paramedics on victims in the attack area where the vegetation and water samples were collected.

59. The Thai have become increasingly worried about chemical attacks against their own forces and civilian population. In March 1981 at least one Thai died from a toxic agent placed by Vietnamese troops and others became ill after suffering bleeding from the nose and mouth; it is not clear how the Thai came in contact with the poison(s). Thai officials have issued strict orders concerning buying food and drink in Kampuchea and the Thai border area. In May 1981, two Vietnamese were captured in a Thai relocation camp for the Kampucheans as they were attempting to poison the water supply. The poison was analyzed and found to contain lethal quantities of cyanide and an unidentified hydrocarbon. (U)

60. In May 1981 the DK was prepared to send two gas victims to Tokyo to be interviewed. In 1980 the Japanese refused to accept a contaminated sample because of Japanese laws governing the import of such material. We do not know what became of the DK victims.

61. An unexploded "B-40" rocket was obtained by the Thai in June after an attack in which two other rockets released poison gas. In July, analysis revealed the movement of trucks loaded with blue sacks filled with white powder. Sources stated that the chemicals caused blindness, hemorrhaging, and vomiting. The chemicals were being moved into the Pursat, Battambang, and Siem Reap areas.

62. The DK began reporting chemical attacks again throughout the period from September to November 1981. These included reports of deaths from aerial and artillery attacks as well as more reporting on water poisoning. In September and October a US doctor and a nurse, affiliated with an international volunteer organization, treated DK victims of a chemical attack in a DK hospital. Blood samples were rushed to the United States for analysis on two occasions.[11] The nurse related the DK version of the attack, which differs from descriptions of other attacks. While retreating from combat with the Vietnamese, DK soldiers hit tripwires that set off some type of chemical smoke pots, killing some 20 soldiers and making many others ill for more than a month. Another report, on 13 November, described a similar incident early that month when a DK unit, withdrawing from a clash with Vietnamese forces, activated devices "hanging in the trees" which disseminated toxic chemicals. (b)(3)

63. In March 1979, during PAVN operations against Khmer Rouge forces in the Phnom Melai area, a PAVN private observed the following related to chemical warfare activity. At a point in the fighting, all regiment (740th) troops were issued gas masks. However, the 2nd Battalion, a "border defense unit," was not issued masks (reason unknown). This unit was in the Phnom Melai area and was virtually surrounded by Khmer Rouge forces. At a point in the fighting, the regiment's troops were ordered to fix masks. The source allegedly saw two Soviets (Caucasians) fire a "DH-10" (the weapon was so identified by the source's comrades). The source was approximately 50 meters from the firing point. The weapon at impact (which the source apparently was able to observe from his position) gave off clouds of white, gray, and green gas/smoke. His signal unit subsequently passed a message which reported that there were 300 dead, including Khmer Rouge and Vietnamese of the border defense 2nd Battalion. The source claimed to have seen the dead. The corpses had traces of white and green powder on their faces and clothes. The faces were contorted, with eyes wide open. No blood was seen. We note that a H'Mong resistance leader described an incident in 1981 where two Soviet soldiers fired a hand-held weapon that dispersed a lethal agent.

(b)(1) (b)(3) (b)(1) (b)(3) (b)(3) (b)(1) (b)(1) (b)(3) (b)(3)

[10] See annexes B and D.

[11] See annexes B and D

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III. THE SOVIET CONNECTION

Key Judgment: The one hypothesis that best fits all the evidence is that the trichothecene toxins were developed in the Soviet Union, provided to the Lao and Vietnamese either directly or through transfer of technical know-how, and weaponized with Soviet assistance in Laos, Vietnam, and Kampuchea. There is no intelligence at hand to support alternative explanations, such as completely independent manufacture and use by the Vietnamese. It is highly probable that the USSR also provided other chemical warfare agents. While the evidence on the Soviet role does not constitute proof in the scientific sense, the Intelligence Community finds the case to be thoroughly convincing.

The Soviet Role in Southeast Asia

64. The Soviets have had advisers and technicians working in Vietnam, Laos, and Kampuchea for many years, but it was not until early 1979 that evidence surfaced on their direct involvement in chemical warfare activities. ordered the Southern Region command in Pakxe to prepare its chemical storage facilities for inspection by unidentified Soviet military personnel. the chemicals to be inspected were those that cause "stomach sickness and death."

65.

66. A separate source stated that the chemical section in Xiangkhoang prepared Soviet-manufactured chemical items for inspection by a Soviet military team on 7 February 1979. A seven-man Soviet team of chemical artillery experts, accompanied by Laotian chemical officers, inspected chemical supplies and artillery rounds at the Xeno storage facility on 1 June 1979. One report stated that the Soviets would be inspecting the same chemical explosives used to suppress the H'Mong resistance in the Phou Bia area

(b)(1) (b)(3)

67. In addition to the intelligence information cited above, which we believe to be reliable, there have been a number of eyewitness accounts of Soviet advisers and technicians participating in the preparation of the chemical weapons for the attacks on the H'Mong villages. Several Laotian defectors have reported seeing Soviet advisers present when aircraft were loaded with chemical-agent rockets. We have not been able to confirm a report that the Soviets have a factory in Vientiane where they mix agents and prepare them for shipment to the regional storage facilities. H'Mong eyewitnesses claim to have seen "Caucasian pilots" in aircraft, and one H'Mong report states that a Soviet aircraft was found in the jungle with a dead Soviet pilot. In November 1981 a H'Mong resistance leader described how Soviet soldiers fighting with the Lao used hand-held weapons that fired chemical munitions a distance of 200 to 300 meters. The lethal chemical dispersed from the munition had a killing radius of 15 meters. This type of report remains suspect, but is not dismissed because of the known Soviet involvement with the Laotian chemical warfare program. (b)(3) (b)(1) (b)(3) (b)(3)

68. In February 1982, information was received that supports the contention that the Soviets supply chemical weapons to the Vietnamese. A Soviet shipment of wooden crates filled with canisters of "deadly toxic chemicals" was unloaded at the Ho Chi Minh City port in July 1981, according to a former official of the Public Security Office of the Vietnamese Ministry of Interior; this office is responsible for special port security. Through personal observation and debriefings of security personnel, he was able to describe the July incident, in which Vietnemese soldiers were caught pilfering the wooden crates containing the chemical canisters. Special security personnel, who were always present when sensitive military shipments from the USSR were offloaded, immediately isolated the area and told soldiers that the round canisters, which were individually sealed in nylon, contained "deadly toxic substances." The wooden crates, each weighing 100 kilograms, were loaded on military trucks and taken to the Long Binh Storage Depot under special guard. (b)(1) (b)(3) (b)(3) (b)(1) (b)(3) (b)(3)

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69. The Soviets have most likely been shipping chemical munitions to Vietnam for many years. In 1975 a source who participated in an operation in the Black Sea to salvage the sunken wreckage of a ship that had been carrying supplies to Vietnam described how the divers were affected when they attempted to remove toxic chemicals. A special Soviet salvage unit took over the operation after the divers became ill. The source was told that the substance was a deadly "dust"-like material.

70. Two Vietnamese corporals from the 337th and the 347th PAVN divisions stated in recent debriefings that Soviet-supplied chemical weapons were stored in caves near Lang Son at the time of the February 1979 Chinese incursion into Vietnam. Division units were issued gas masks, but were told that the Soviet-supplied chemical weapons would not be used unless the Chinese initiated chemical warfare. Both sides later charged that the other used chemical weapons, but there is insufficient evidence to substantiate any of the claims.

71. Since the first reports of chemical attacks in Southeast Asia in 1976, we have tended to interpret the Soviet role as strictly advisory. There is considerable evidence now, however, to suggest that the Soviets may be far more involved in the Laotian and Vietnamese chemical warfare program than we assumed in earlier assessments. While more evidence will be needed to make a firm judgment, analysis of the available intelligence leads to the hypothesis that the Soviet military not only aids the effort, but benefits from the use of chemical weapons in Southeast Asia.

Motivation for Using Chemical Weapons

72. The Soviets have made a large investment in ensuring that Vietnam and its puppets succeed in extending their control over Indochina. Much of the Soviets' interest in this region is dictated by their power rivalry with China. Regional Communist forces have been strengthened to contain Chinese influence and deter military incursions. The area of northern Laos where the H'Mong have stubbornly resisted and harassed Vietnamese forces is strategically significant to the Vietnamese because it adjoins a hostile China. In the last few years the Vietnamese have expanded their military construction and strengthened their forces there. For Vietnam, the H'Mong resistance is a major irritant to be removed as quickly and cheaply as possible. To that end, much of the H'Mong population that lived in the Phou Bia mountain region has been driven into Thailand, killed, or resettled. About 50,000 of an original 300,000 (in 1975) remain. The use of chemical agents has played a major role in driving the H'Mong from their mountain strongholds, relieving the PAVN/LPLA ground forces of the need for costly combat in difficult terrain.

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73. The Soviets and their allies were no doubt confident that chemical warfare against the H'Mong in remote regions of Laos could be conducted without detection or at least without effective international opposition or condemnation. They have denied such charges as have been made to date, and have made counterclaims that the United States used chemical warfare in Vietnam. In Kampuchea they may also have calculated that, in view of the lack of international support for Pol Pot's regime, chemical weapons could be used on his troops and troops of lesser known resistance forces without any significant international outcry.

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74. There remains the question of the choice of chemical agents and particularly of toxins that cause such bizarre and horrifying symptoms. Chemical weapons offer some real advantages over conventional bombing and artillery strikes, napalm, white phosphorus, and infantry operations. Caves and rugged terrain in Laos and thick jungles in Kampuchea have frustrated attempts to locate and destroy the resistance forces. Chemical clouds can penetrate the heavy forests and jungle canopy and seep into the mountain caves. Persistent agents linger in the area and cause casualties days and sometimes weeks after the attack. Unprotected forces and civilians have little defense against lethal agents including toxins, nerve agents, and blister agents.

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75. Trichothecene toxins have the added advantage of being an effective terror weapon. Severe bleeding, in addition to blisters and vomiting, instilled fear in the resistance villages. Not only are the villagers and their animals being killed in a gruesome manner, but the vegetation and water also are contaminated. Survivors are loath to return to their inhospitable homes and

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instead make the long and dangerous trek to camps in Thailand.

76. There is no clear-cut explanation of why trichothecene toxins have been used in addition to irritants, incapacitants, and other traditional chemical warfare agents. We can only speculate that they are probably cheaper to make and are readily available from Soviet stocks; they are probably safer and more stable to store, transport, and handle in a Southeast Asian environment, and may require less protective equipment when being prepared for munitions. It is clear that they have caused high casualty rates and have been effective as a terror weapon. Moreover, they are difficult to trace as the causative agent after an attack—as demonstrated by the long-delayed US detection. Very few laboratories in the world have the analytical capability to identify precisely the type and amount of trichothecene toxin in a sample of vegetation, soil, or water.

77. Several of the H'Mong reports suggest that Southeast Asia is being used as a laboratory to test chemical weapons. In one case, Vietnamese and Laotian troops entered a village after an attack and took about 20 survivors to a hospital for examination. Victims were treated with different antidotes. The detailed description provided by a H'Mong, who was one of the survivors taken to the hospital, is one of the few cases available on poststrike medical analysis.

78. We suspect that the Soviets, Vietnamese, and Laotians have gained significant information on chemical agent effects on humans, although information on poststrike analysis is very limited. Years of aerial and artillery chemical dispersion has undoubtedly provided the Soviets with valuable testing data. Southeast Asia offered the Soviets an opportunity to test old agents that had been stockpiled for many years as well as more recently developed agents or combinations of agents. A common feature in the descriptions of chemical attacks is the delivery of several types of agents on a single target, sometimes simultaneously, more often sequentially. In some cases, irritants or incapacitants were used first, followed by a second attack with a lethal agent.

Alternative Explanations

79. As a further check on our inference of a crucial Soviet role in the chemical warfare activities in Indochina, we have hypothesized and considered the plausibility of several alternative explanations of the phenomena observed. These hypotheses are described in the following paragraphs. It is our opinion, however, that none of these alternatives fit the data as well as the hypothesis of a direct Soviet connection.

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80. ***Are the Vietnamese and Laotians using captured US chemical stocks?*** The Vietnamese are known to be using captured US aircraft, artillery, munitions, and chemicals such as smoke flares, and the riot-control agent CS. However, the United States did not have lethal agents in Vietnam, and stocks of defoliant were removed long before the Vietnamese Communists took over. The United States had no chemical agents in Vietnam or in the US stockpile that would cause symptoms of the sort associated with "yellow rain" or other lethal chemical attacks observed in Indochina. Agent Orange or any other defoliant would not cause the types of visible physical symptoms and death reported from Laos and Kampuchea.

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81. ***Are the allegations made by the H'Mong and Democratic Kampuchean forces part of a systematic propaganda or misinformation campaign designed to discredit their enemies?*** The evidence, especially after early 1979, is not based solely on refugee reports. However, the H'Mong refugees have been interviewed by doctors, journalists, international refugee groups, congressmen, governors, and officials from several governments. Every qualified observer reported that he believed the H'Mong were describing a tragic event that happened to them, their families, and friends. It is highly unlikely that men, women, and children for over five years have engaged in a sophisticated propaganda campaign that would require considerable medical knowledge of what we now know was toxin poisoning. Furthermore, the H'Mong have not had a well-organized propaganda effort concerning their plight and their story has been championed mainly by interested private citizens and a few governments. Pol Pot, on the other hand, does have a well-established propaganda apparatus that caused analysts to distrust the early reports of chemical weapon use against his Democratic Kampuchean forces. By the summer of 1981, evidence from non-DK sources had fully substantiated the earlier charges.

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82. ***Have the Vietnamese and Laotians produced their own chemical agents or purchased them from countries other than the USSR?*** It cannot be ruled out that the Vietnamese, and perhaps even the Laotians, have produced some chemical warfare agents on their own or purchased chemical weapons or the materials to make agents and delivery systems. Some of the traditional agents like mustard or chlorine could certainly have been prepared in an indigenous chemical laboratory, and the Vietnamese have sufficient capability to manufacture crude delivery systems. Thus far we have positively identified only one class of the agents used—trichothecene toxins—on the basis of analyses of samples from Laos and Kampuchea. These analyses [12] reveal that these particular trichothecenes would not occur naturally in Southeast Asia in the observed combinations and concentrations. It is possible that the Vietnamese could purchase the cultures to make the agent, but that seems most implausible. Rather, it is much more likely that the Soviet Union has produced the toxins for the Vietnamese and supplied the technology to weaponize the toxin. The Soviets have more experience than any other country with these particular trichothecene toxins and have an extensive chemical warfare program in which they could produce and test them. They also have extensive biological facilities in which they could produce the toxin in the large quantities required.

83. ***Did the reported deaths occur as a result of the poor physical condition of a population exposed merely to riot control agents?*** Several university studies and US Government investigations show that the H'Mong and the Democratic Kampuchean forces are generally in good health and would not have been killed by riot-control agents. Conjectures that many refugees suffered from diseases like tuberculosis and would therefore be vulnerable to nonlethal choking agents are unfounded. It is possible for victims trapped in caves or tunnels to die from a heavy dose of riot-control agent, especially a vomiting agent like adamsite. Few reports, however, describe deaths in caves or tunnels. Most attacks occurred in open air over villages. Credible alternate explanations for the blisters and other symptoms observed on survivors by doctors in Thailand have not been forthcoming. These symptoms are not of the type associated with any known diseases, nor do they resemble those caused by mustard gas. (b)(3)

[12] See annexes B and D.

IV. CHEMICAL WARFARE IN AFGHANISTAN

Key Judgment: Soviet forces in Afghanistan have used lethal and casualty-producing agents on Mujahedin resistance forces and Afghan villages since the December 1979 invasion. There is some evidence that Afghan Government forces may have used chemical weapons provided by the USSR against the Mujahedin even before the invasion. No agents have been identified through sample analysis, but we conclude from analysis of all the evidence that attacks have been conducted with irritants, incapacitants, nerve agents, phosgene oxime, and perhaps trichothecene toxins, mustard, lewisite, and unidentified toxic smokes. (b)(3)

Nature of the Evidence

84. (b)(3) Since 1979 a total of 47 separate chemical attacks against Mujahedin guerrillas and villages have been reported by human sources, including Mujahedin resistance fighters, Afghan Army officers, journalists, and medical experts from the United States, Afghanistan, Germany, and France. In the chemical assaults as a whole, a minimum of 3,042 of the Mujahedin reportedly were killed.[13] (b)(3) (b)(3)

85. The reports of chemical warfare attacks indicated that fixed-wing aircraft and helicopters were usually employed to disseminate CW agents by rockets, bombs, and sprays. Chemical-filled landmines were also reportedly used by the Soviets. The chemical clouds were usually gray (or blue-black), yellow, or a combination of the two colors. (b)(3)

86. Medical symptoms reported by victims and witnesses of attacks indicate that nonlethal incapacitating chemicals and lethal chemicals—including nerve agents, phosgene or phosgene oxime, possibly trichothecene or other toxins, and mustard—were used. Several descriptions of the physiological action of

[13] See annex A. (b)(3)

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Figure 7
Mujahedin Guerrilla Killed During an Attack on Charbagh Safar Village, Summer 1980

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a chemical agent or of the condition of the corpses of victims were particularly unusual. In one, victims were rapidly rendered unconscious for two to six hours and had no aftereffects. In another, the condition of the bodies included abnormal bloating and blackened skin with a dark reddish tinge, and the flesh appeared decayed. (See figure 7.) In a third incident—which defies explanation—three dead Mujahedin guerrillas were found with hands on rifles and lying in a firing position, indicating that the attacker had used an extremely rapid-acting lethal chemical that is not detectable by normal senses and apparently causes no external physiological responses before death.

87. We have reliable information from several sources that the Soviets had a variety of CW agents available in Afghanistan. Agents included nerve gases, vesicants, and several other casualty-producing agents.

88. A former Afghan Army ordnance officer reported that the Soviet army has stockpiled large amounts of artillery shells and handgrenades containing phosgene, diphosgene, sarin, and soman. Stockpiles are in storage sites located in Kabul; in Bala Hissar, at the airport site referred to as Khafaramanag in an underground storage depot; in the Khair Khana district military storage depot near Qandahar City; near Herat; and at the provincial airports of Shindand and Jalalabad. (b)(3)

89. (b)(1) indicated the use of (b)(3) chemical warfare agents in Afghanistan as early as 31 May 1979, seven months before the Soviet invasion. It is not known whether Soviet or Afghan pilots conducted the attacks. The chemical munitions were referred to as "microbe bombs" or "chemical bombs" and were to be used to "destroy the Muslims," suggesting a lethal agent. (b)(1)

90. (b)(1) the location of chemical bombs, training in CW, and training of Afghan troops in the use of gas masks and the use of lethal chemicals. For instance, on two occasions on 21 August 1980, Soviet aircraft reportedly dropped chemical bombs on a village near Herat, killing 300 insurgents and their sympathizers. (b)(3) (b)(1)

91. (b)(3) confirmed the use (b)(3) of chemical munitions by the Soviets against the Mujahedin. These reports neither confirm nor refute the use of lethal chemical agents. One report (b)(1) indicated that Afghan and Soviet (b)(3) units used helicopters to disseminate "poisonous gas causing many deaths." Other intelligence shows that: (b)(3)

— Toxic smokes, possibly organic arsenical compounds, were brought into Afghanistan and later withdrawn by the Soviets. (b)(3)

— Chemicals were used to drive insurgents from caves, after which they were attacked conventionally by helicopters.

— Col. Gen. V. K. Pikalov, chief of Soviet chemical troops, and other officials visited a site that had (b)(3)

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been attacked with a CW agent, designated "IF." [14]

— Soviet units in Mazar-e Sharif had depleted supplies of sodium hydroxide, a potent CW decontamination chemical, and had requested that more be sent immediately.

92.

93. the presence of Soviet CW reconnaissance and decontamination units at Kabul, Shindand, and Chaghasaray airfields.

94. ***Sample Collection and Analysis.*** Efforts to collect contaminated environmental samples, Soviet equipment, and materials from Afghan victims of CW were initiated in early 1980. The first sample of rocket tube and warhead fragments was collected in Konarha Province. Since then, 13 additional samples, including Soviet gas masks and clothing from gas victims have been collected for analysis. The last of these, a grain sample, was received in mid-February 1982.

[14] A Soviet designation for several pathogenic Fusarium products or systems is "IIF," which stands for "artificial infection background" (*iskusstevnnyy infektsionny fon*). IIFs involve deliberate contamination of soil in test areas with spores of disease-producing fungi. We do not know if these IIF systems include compounds which are trichothecenes, or even if the IIF and IF designators have a common origin in language. But elsewhere in the Soviet agricultural research program it is known with certainty that there is widespread use of certain trichothecenes involving systems of spray dissemination from light aircrft. A capability exists for multiton production at several Soviet facilities, and such production is known to exist for other spray-delivered microbial products as well.

95. Analysis to date has not revealed any standard, known CW agent or trichothecene but analysis is not complete.[15] (b)(3)

96. ***Medical Examinations.*** Mujahedin refugees, who claimed to have been victims of gas attacks, were examined by medical doctors from the United States, Pakistan, and France. Photographs, descriptions of the symptomatic effects, and descriptions of the corpses of some victims clearly indicate that lethal and casualty-causing agents were used in Afghanistan.[16] (b)(1) (b)(3) (b)(1) (b)(3))(3)

The Evidence

97. The Soviets appear to have used a wide variety of chemical agents in Afghanistan. There are a number of reports that indicate the Afghan military, and possibly the Soviets, used chemical weapons in 1979 before the Soviet invasion. Several Afghan officers have stated that the Soviets supplied both lethal and nonlethal agents to the Afghan forces, in addition to chemical warfare training in the USSR. A substantial body of evidence from all areas of Afghanistan was collected on Soviet chemical attacks throughout 1980. Most of the reports describing large numbers of deaths are from the first three months of 1980 in northeastern Afghanistan. In 1981 more evidence on chemical attacks became available and there are indications that chemical agents will continue to be used. The following paragraphs covering chemical attacks from the summer of 1979 to the fall of 1981 summarize a large body of information. (See figure 10 on page 28.) (b)(1) (b)(3) (b)(1) (b)(3) (b)(3)

98. ***Attacks Before the Invasion.*** (b)(1) (b)(3) (b)(3)

99. A former Afghan Army officer who joined the insurgency claimed that Soviet aircraft dropped canis-

[15] Descriptions of samples and analytical results are in annex B. (b)(3)

[16] See annex E. (b)(3)

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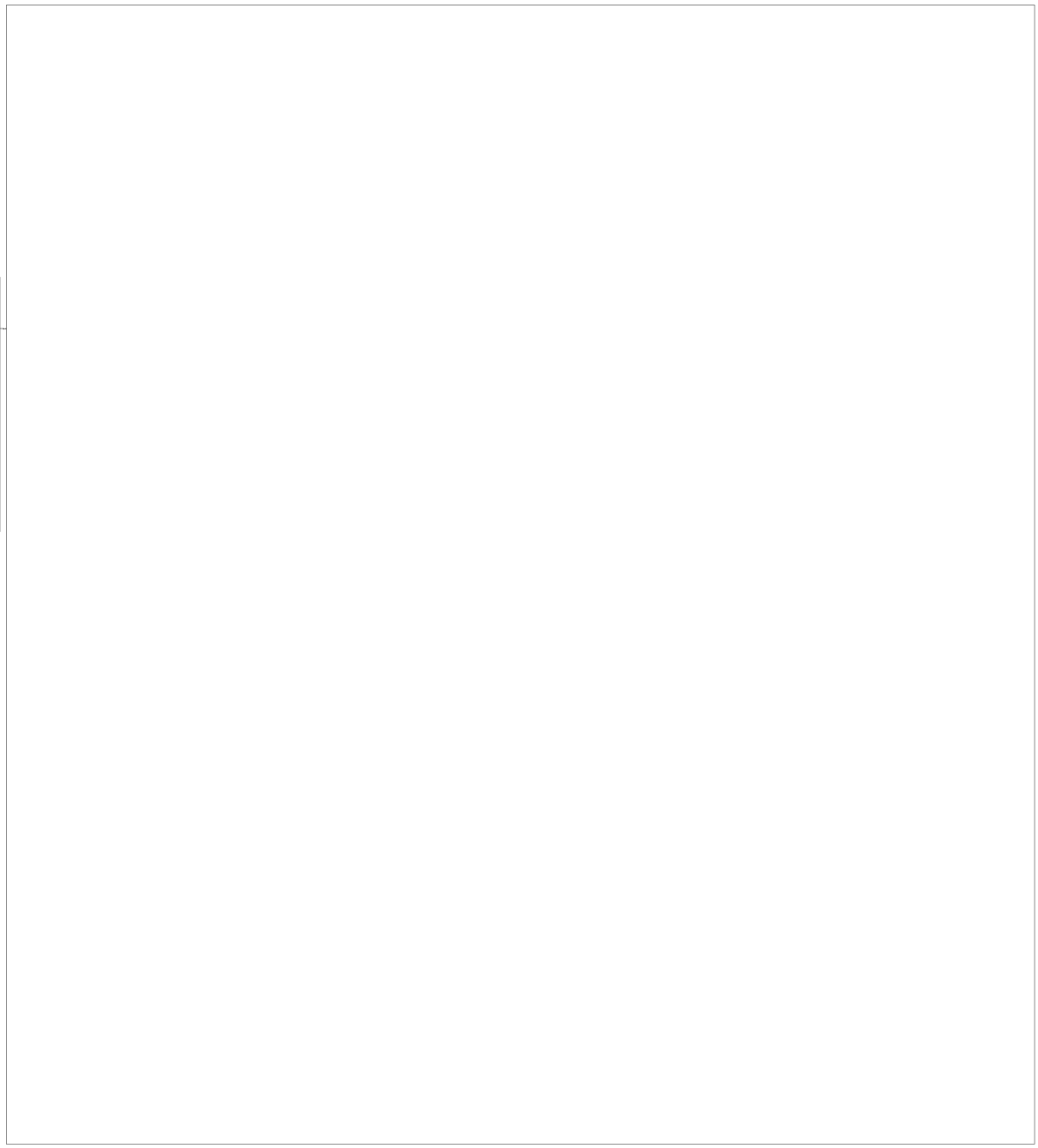

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ters containing toxic gas on insurgents in Bamian Province during June and July 1979. He also reported that rumors circulating in the Afghan refugee community claimed that, in August and September 1979, chemical agents were used to dislodge insurgents attempting to interdict a road in the Salang Pass area northeast of Kabul.

100. An Afghan civil engineer described attacks in August 1979 by possibly MIG-19 or SU-17 aircraft followed by reconnaissance by MIG-25s on a position where a large resistance force was being assembled. He heard that about 2,000 died and personally saw a large number of dead bodies with exposed bones and open wounds that appeared to have been caused by acid. Survivors described an acidlike agent. He was told that the aircraft came from Tashkent in the USSR. He had heard similar reports from Jalalabad and Qandahar. (b)(3)

101. (b)(1)(3)
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102. (b)(1)
six "chemical bombs" were expended, along with conventional air munitions, (b)(3)

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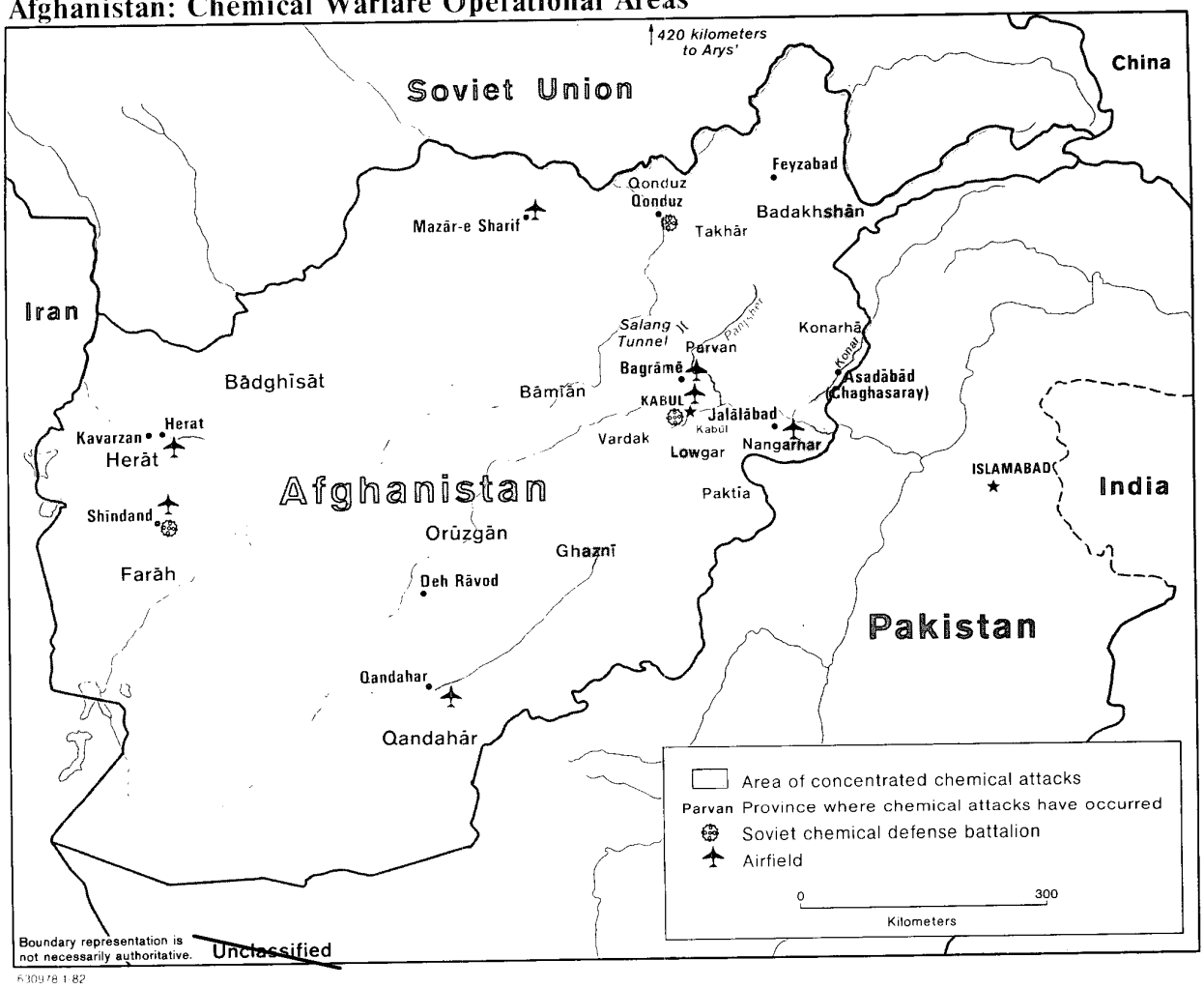
Figure 10
Afghanistan: Chemical Warfare Operational Areas



in a strike by Afghan IL-28 bombers from Shindand on targets in Farah, Herat, and Badghisat Provinces on 16 November 1979. Afghan IL-28s were based at Shindand

103. On 27 December 1979, Soviet jet aircraft reportedly had dropped chemical bombs. The location of this particular attack was not given, but the same report mentioned other chemical attacks in Badakhshan Province.

104. ***Chemical Attacks Following Invasion.*** After the Soviet invasion of Afghanistan on 17 December 1979, reports were received from many types of sources that both Soviet and Afghan forces were using various types of chemical agents. (b)(3)

105. One report speaks of chemical bomb attacks during the week of 13-19 January 1980 against insurgent forces near Feyzabad and Jalalabad, in the Hazarajet area of Bamian Province, and in Takhar Province, all in eastern Afghanistan. The bombs reportedly exploded in midair, dispersing a "vapor" that felt damp on the skin. Inhalation of the vapor is said to have caused difficulty in breathing, nasal excretions, vomiting, blindness, paralysis, and death. These symptoms are associated with nerve agent poisoning. (b)(1) (b)(3) (b)(3) (b)(3)

106. In mid-January there were other reports alleging that Soviet aircraft and helicopters had attacked remote areas in northeastern Afghanistan, particularly

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Badakhshan Province, dropping bombs that exploded and dispersed gas that caused blindness, paralysis, and death. We know that the Soviets launched their first offensive operation in northeastern Afghanistan using air and helicopter strikes from a base inside the Soviet Union and that these air attacks occurred during heavy snowfall against insurgent positions high in the mountain area.

107. In February 1980 a respected Australian journalist and a US official spoke with Afghan refugees from different ethnic tribal areas who described chemical agent attacks that allegedly occurred in several Afghan provinces. One tribal group reported that attackers dropped canisters dispersing a gas but that no casualties occurred. A reported chemical agent attack in another area allegedly caused some people to become ill but did not cause any deaths. Reports from some refugees from Badakhshan Province have alleged that an unspecified number of deaths occurred as a result of exposure to chemical agents used in attacks in that area.

108. Another set of reports that recently became available, concerning the period from mid-January to February 1980, described helicopter attacks in northeastern Afghanistan in which a grayish-blue smoke resulted in symptoms similar to those described by the H'Mong refugees from Laos (heavy tearing or watering of eyes; extensive blistering and discoloration of the skin, later resulting in large sheetlike peeling; swelling in the areas affected by the blister; and finally numbness, paralysis, and death).

109. In early March, following the Soviet offensive in Konarha Province on the Pakistani border, Afghan refugees arriving in Pakistan provided new reports of chemical agent attacks. But, unlike earlier reports describing attacks in which deaths allegedly occurred, these reports describe attacks with an incapacitating agent. In addition to these reports, there are several reliable ones which state that the Soviets used incapacitating agents during the Konarha offensive to allow Soviet forces to overrun resistance forces and capture prisoners.

110. Medical examinations in Pakistan of refugees from a large attack in the upper Konar Valley in February 1980 described red skin and blisters containing fluid described as dirty water. Refugees reported that about 2,000 people were affected after contact with a dirty yellow cloud. (b)(3)

111. An Afghan doctor who worked in Qonduz reported the same type of incapacitants and blister agents as those being used in Konarha, Paktia, and Badakhshan Provinces. (b)(3)

112. (b)(1) (b)(3)

113. (b)(1) (b)(3)

114. (b)(1) (b)(3) (b)(3)

115. The Soviet 108th Motorized Rifle Division (b)(1) (b)(3) Troops were to wear gas masks when using the grenades and wash their eyes if exposed. By August, more than 2,700 toxic smoke grenades were received, (b)(1) (b)(3) (b)(3) Other divisions also had toxic smoke grenades, which complicated the withdrawal to the USSR. (b)(1) (b)(3)

116. A Japanese academic in March 1980 at a training camp in Peshawar saw an 8-mm film that showed Soviet helicopters dropping several objects, which caused no explosion and produced a bluish-purple smoke mixed with gray and white, probably in an area northwest of Jalalabad. He was told the attacks caused numerous deaths, but the Hezbi-Islami Party, which operates in that area, refused to make the film available to any international organizations. They believed they were fighting a holy war and did not need to prove that international law was being violated. (b)(3) (b)(3)

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117. An Afghan officer trained in chemical warfare in the USSR described the use of incapacitants and blister agents in Afghanistan and remembered their characteristics as described in Soviet manuals. He said the incapacitant munition is effective in a 50-meter radius and causes unconsciousness for varying periods.

118. Col. Gen. V. K. Pikalov, chief of the USSR's chemical troops, brought 20 Soviet officials to tour Afghanistan in April 1980. They were specifically interested in investigating the use of toxic agents in the Herat area. "IF" was the only identification of the agent used On 25 March the Afghan Government had publicized the capture of "lethal US grenades" provided to the resistance. In fact, it was a US riot-control grenade readily available commercially for police forces. According to a reliable source, however, the Soviets used lethal agents near Herat in March and placed the blame for the incident on US-provided chemical weapons used by the insurgents.

119. A Dutch journalist published his eyewitness account of two chemical attacks in the Jalalabad area on 15 and 21 June 1980. He filmed the MI-24 helicopter dropping canisters that produced a gray-white cloud. A victim with blackened skin was photographed (figure 7 on page 23) in the village five hours after the attack. The journalist evidently was exposed because he developed blisters on his hands and a swollen and itchy face. He was exposed in the second attack and it took about 10 days for him to recover from skin lesions, nausea, diarrhea, and stomach cramps. This is one of the best firsthand accounts available from Afghanistan. The agent has not been identified, but it could be a mixture containing phosgene oxime or hydrogen sulfide along with other components.

120. A US journalist described seeing a yellow-green gas that appeared to him to be a highly concentrated CS-type gas with a blister agent associated with it. He said the canisters containing the incapacitating gas were "18 inches long and 8 inches in diameter," which corresponds with many other reports from Afghans. We had heard reports about a lethal gas that causes unconsciousness and then death. (b)(3)

121. In August 1980, (b)(1) (b)(3) Soviet attack with chemical bombs on the village of Sya Wusan, 30 kilometers southeast of Herat, leaving 300 dead. Afghan military authorities told doctors in Herat they could not treat the victims and doctors' offices were closed. It was in this time frame that the chemical battalion at Shindand set up an operational decontamination station. (See figure 12.) (b)(1) (b)(3)

122. ***Chemical Attacks in 1981.*** Soviet helicopter units participated in chemical attacks from 20 to 29 April 1981, in areas east and west of Kabul and in the Konar Valley. These attacks were intended to drive personnel from sanctuaries such as caves in order to engage them with conventional fire. (b)(1) (b)(3) Similar operations by helicopters occurred north of Qandahar on 24 and 26 April. (b)(1)

123. An Afghan MI-8 helicopter pilot who defected to the Pakistanis said Soviet forces had used chemical weapons in Badakhshan, Qonduz, and Konarha Provinces. Chemicals in canisters that contained toxic gas, tear gas, and antirespiratory gas, which has an incapacitating effect by causing choking and difficulty in breathing, were manually pushed from the cargo compartments of helicopters. He said there was also a specific gas that is absorbed by the body and leaves the skin so soft that one can pierce it with a finger. In one case, there was a wind shift, and Soviet and Afghan forces were seriously affected. Other sources also have described an incident where Soviet and Afghan forces were victims of their own gas attack. (b)(3) (b)(3)

124. A US doctor of Afghan origin examined victims of a July 1981 attack. His report is detailed in the annex on medical evidence.[17] (b)(3) (b)(3)

[17] See annex E. (b)(3)

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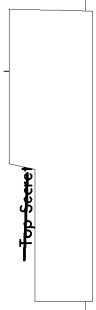

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125. Before a Soviet sweep operation in the Konar Valley in September 1981, resistance leaders were told by an Afghan officer that the Soviets had four agents available, but would use only the incapacitant which they could defend against with wet rags over the face. During the operation, Soviet helicopters conducted gas attacks in 25 different areas, using cylinders about 1.5 meters long and 60 centimeters in diameter that exploded 4 to 5 meters above the ground, releasing the incapacitating gas. Some victims lost consciousness, were paralyzed, and recovered; others died, and unprotected areas of their skin turned dark green to blue-green.

126. ***CW Agents Used.*** A recent report from a wounded Mujahedin fighter in a Karachi hospital reinforces our suspicion that previously unidentified toxins or nontraditional CW agents have been used. This man, described as an expert on Soviet ordnance and use of chemical weapons (but not chemical-biological aspects), told US Embassy personnel on 10 February 1982 that the Soviets are using irritants, a hallucinogenic gas, and an apparent nerve gas. The "nerve gas" was described as an off-white powder generally dispersed from helicopters during artillery or aerial bombing attacks. He said the substance is hard to detect. Victims feel faint and dizzy; subsequently they vomit and began to bleed from the eyes, nose, and mouth. Death rates approach 70 percent. Dead bodies are relaxed and the skin peels off when an effort is made to move the bodies. This sequence of symptoms is consistent with trichothecene toxin poisoning, not nerve agents. This source's cogent and detailed description of symptoms of survivors, up to six months after an attack, are similar to numerous reports from Southeast Asia and supports the growing body of as yet unevaluated claims that toxins cause long-term health effects.

127. The Mujahedin regarded gas as simply another weapon in the Soviet arsenal and had to be urged to discuss CW use. This is typical of the Mujahedin attitude toward the US "preoccupation" with chemical warfare and contributes to the intelligence conclusion that Mujahedin reports of chemical attacks, like the H'Mong refugee reports on CW use in Laos, are not part of a fabricated propaganda campaign.

128. To substantiate the descriptions of chemical attacks in Southeast Asia and Afghanistan, details of reported attacks were checked against military operations at the specific time and place. In a high percentage of the cases studied, military operations of the type described by the victims of chemical attacks did take place. For example, an Afghan emigre in Europe recently repeated a description by an Afghan tribal leader of a Soviet chemical attack with helicopters on a 700-man force that had gathered to conduct a surprise attack on Qandahar in October 1981. (b)(1) (b)(3)

(b)(1) (b)(3)

129. The most persuasive case studies are those where samples have been collected and analyzed. Thus far that has been possible only for attacks in Southeast Asia; but the Afghan emigre stated that green gas canisters, which emitted a green-yellow smoke upon hitting the ground, were taken to Pakistan by some of the 400 survivors of the October attack. Attempts are being made to acquire the canisters. (b)(3)

130. We have reliable information that the Soviets have stockpiled lethal and casualty-producing agents in Afghanistan and information, also reliable, on where and when some of them have been used. The agents included nerve agents, phosgene, phosgene oxime, sulfur mustard, and lewisite. The agents used, plus the time and location of the attacks, generally correspond to the refugee reports and recorded military operations. Afghan military defectors have also described the agents being used by the Soviets and pinpointed where they are stored. (b)(3)

131. ***Soviet Chemical Defense Equipment and Units.*** A number of former Afghan officers have described their chemical warfare training in the USSR, and have listed the different types of agents available to the Afghan military and the Soviets in Afghanistan. Their reports, which date back to early 1980, are similar to a recently acquired clandestine report, except that they described the symptoms caused by the chemical agents without naming them. A former ordnance officer described where the agents were (b)(3)

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Table 1

Major Soviet Chemical Defense Equipment at Division Level

Equipment	Units and Number			
	Chemical Battalion	Four Chemical Companies	Other Divison Units	Total
BRDM-RKh [a]	9	16	4	29
TMS-65 jet engine	2	0	0	2
ARS-12/14 [b]	20	12	3	35
DDA-53/66 [c]	4	4	6	14

[a] Wheeled reconnaissance vehicle with chemical, biological, and radiological detection equipment.
[b] Truck-mounted device that uses fluid under pressure to decontaminate terrain and equipment.
[c] Truck-mounted steam chambers for decontamination of clothing.

(b)(3)

stored in Kabul, Herat, Shindand, Qandahar, and Jalalabad.

132. Chemical defense battalions—standard in all Soviet divisions—are deployed with the three Soviet motorized rifle divisions operating in Afghanistan at Qonduz, Shindand, and Kabul. Also a chemical company is subordinate to each tank and motorized rifle regiment.

133. The chemical defense battalion is normally equipped with the TMS-65 decontamination vehicle (truck mounted, jet engine), the DDA steam generator, and the ARS spray-type decontamination equipment. Such equipment has the primary mission of reducing the effects of chemical, biological, and nuclear contamination. A secondary mission for the TMS-65 is to lay smokescreens, and for the DDA device to generate hot water for showers.

134. The table of organization of these units includes the major equipment items listed in table 1.

135. Soviet divisional chemical defense forces are sufficient to decontaminate division equipment but are capable of only relatively modest-scale terrain-decontamination operations. If the Soviets were planning fairly widespread use of persistent chemical agents and operations in contaminated areas, additional chemical defense units probably would be required. Such nondivisional units—subordinate to either army or military district headquarters—are located in most military districts in the USSR, but none have been seen in Afghanistan. (b)(3)

136. The nondivisional chemical defense unit closest to the Afghan border is the 126th Chemical Defense Battalion located in Bukhara, in the Turkestan Military District, about 300 kilometers from the border. This unit appears to be manned at no more than half strength and probably would need to be augmented by reserve personnel before deploying outside the USSR. (b)(1) (b)(3)

137. Chemical defense equipment, apparently a reserve stockpile, also is stored in Dushanbe and Kurgan-Tyube in the Central Asian Military District at installations formerly occupied by elements of the 201st Motorized Rifle Division. This equipment was not moved out of the two installations, however, when the division moved into Afghanistan. (b)(3)

138. (b)(1) (b)(3)

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(b)(3)

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Decontamination vehicles also have been seen in the Kabul area.

139.

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141.

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Decontamination and reconnaissance equipment accompanied a 152-mm artillery unit into operations in the Konar Valley, near Chaghasaray.

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142. Soviet troops in Kabul have been observed with what appear to be gas masks in canvas carrying

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cases; and, Soviet forces were instructed to don masks when using "toxic/noxious" grenades. Also, on 24 February 1980 many Soviet troops became ill from carbon monoxide poisoning when they were caught by a traffic jam in the Salang tunnel because they did not have special protective canisters required for carbon monoxide.

143. ***Soviet Offensive CW Capabilities.*** The Soviet Union has stocked a variety of toxic chemical agents and munitions to meet wartime contingencies. Weapon systems capable of delivering chemical munitions available to Soviet forces in Afghanistan include artillery, multiple rocket launchers, and most tactical aircraft. (See table 2.)

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(b)(3)

144. Field artillery can be used to disseminate CW agents in large concentrations for short ranges. Chemical artillery munitions (as well as aerial bombs) include both fragmentation and nonfragmentation varieties.

(b)(1))
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Dissemination efficiencies (the amount of agent deposited after dissemination) as high as 90 percent apparently have been achieved with Soviet base-ejection

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Table 2

Soviet CW Agents and Weapons Systems

Agent	Artillery Munitions (size in millimeters) [a]	Free Fall Bombs (weight in kilograms) [a]	Rocket Warheads [a]
Nerve			
Thickened Soman	—	100	FROG
Sarin	122, 152	100, 250	BM-21
			BM-24
Vesicant (Blister)			
Mustard	122, 152	—	—
Thickened Mustard	122, 152	—	—
Thickened Lewisite	122, 152	—	—
Mustard/Lewisite Mixture	—	100, 250, 500, 1,000, 1,500	—
Thickened Mustard/Lewisite Mixture	—	250, 1,000	—
Systemic			
Hydrogen Cyanide	—	250, 500	BM-21
			BM-24

[a] Entry indicates availability of delivery system for agent specified.

(b)(3)

shells, (b)(1) (b)(3)

145. The lethal agents listed in table 2 are known to be in the Soviet inventory. It has been confirmed that a Soviet agent known as VR-55 is the nerve agent soman (GD) thickened with 3- to 5-percent polymethylmethacrylate. Unthickened soman (GD) may be considered by the Soviets as a viable agent fill for munitions, but the thickened version appears to be favored. Tabun, VX, toxins, and phosgene oxime, on the basis of recent information, may have become standard agents.

146. The Soviets have been interested in the US binary weapons program for over a decade and apparently have conducted research and development in such weapons and may have even tested a few rounds. The Soviets issued a patent for a reaction involving an oxime and an alcohol to yield two CW agents: a nerve agent and phosgene oxime (an urticant). There is, however, no evidence that the Soviets have binary weapons in their inventory.

147. About a dozen major installations in the USSR are known to store chemical defense equipment and are suspected of also storing chemical munitions and/or bulk supplies of agents. One of these—the facility near the town of Arys' in the Central Asian Military District—is located about 500 kilometers from the Afghan border. Although chemical shells reportedly were stored near Arys' before World War II, we cannot confirm that toxic munitions are now being stored at this installation. Any munitions stored there today could be moved by rail to Termez—and then overland across the border—or directly into Afghanistan by air. (b)(1) (b)(3)

(b)(3)

148. (b)(1) (b)(3)

(b)(3)

Analysis of information from several sources convinces us that in Soviet CW exercises the crews loading CW munitions onto aircraft do not wear protective clothes, nor is decontamination equipment present. (b)(1) (b)(3)

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149. Because Afghan insurgent forces have little or no protection, there are several situations in which the use of chemical weapons could be an attractive alternative to conventional munitions. In mountainous areas, where rebels are holed up in caves or other inaccessible areas, conventional artillery, high-explosive bombs, and napalm are not particularly effective. an unidentified agent has been used on this kind of target.

150. Another possible use for lethal agents would be to deny terrain to rebel forces. Using persistent agents, the Soviets could contaminate large areas for up to three to five days, especially by air-delivered munitions. Contamination of terrain also could be used to force insurgents into areas more accessible to Soviet troops or into conventional fire zones. Under ideal temperature and wind conditions, the persistent nerve agent thickened soman would be the most effective agent. A KhAB-100 bomb filled with a nerve agent such as soman could cover 4,000 square meters with a contamination density of 7.25 grams per cubic meter and would kill all unprotected individuals.

151. ***Effects of Weather and Terrain.*** The effectiveness of CW agents is heavily influenced by the terrain, wind, and temperatures. Much of Afghanistan is mountainous, and at elevations below 1,200 meters temperatures rise to more than 38 degrees Celsius nearly every day from June to September. There are few trees, and the centuries-long practice of seeking fuel and forage in this already barren land has denuded the hillside of scrub and bushes. The effectiveness of chemical agents would be degraded in such a harsh environment. Strong gusty winds characteristic of barren mountains would decrease the density of the contamination, and more agent would be required to maintain a lethal concentration. Also, the cold temperatures in winter and during fall nights would reduce the vapor hazard to a minimum. As temperatures rose during the day, however, the agent would vaporize and the hazard would increase. The best dissemination periods in Afghanistan probably would be around sunrise during the spring and fall months.

152. An Afghan officer who defected described chemical attacks with lethal agents from 13 to 19 January near Bamian, Feyzabad, Jalalabad, and Takhar. The US Air Force studied the weather over these areas for that period and concluded that conditions were favorable for the aerial delivery of nerve agents on at least two days at each location. The Soviets are actively engaged in testing methods of disseminating agents to allow delivery on target with minimum influence from certain meteorological conditions. They have tested chemical aerial bomb delivery from light bombers and helicopters as well as multiple rocket launchers and artillery at the Shikhany test range. (b)(1) (b)(3) (b)(3)

V. THE CASE FOR CW USE OF TRICHOTHECENES [18]

Sample Analyses for the Trichothecenes

153. Many of the reports of chemical attacks in Southeast Asia were puzzling in that they described the use of a lethal agent (or agents) that produced symptoms not easily correlated with those known to be produced by traditionally recognized chemical warfare agents.[19] (b)(3)

154. The symptoms most frequently described in Laos and Kampuchea correspond most closely with those produced by a group of mycotoxins, the trichothecenes. Particularly unusual was the repeated description by medically unsophisticated victims of symptoms indicating hemorrhage and degeneration of the mucosal lining of the gastrointestinal tract, symptoms characteristic of trichothecene poisoning.[20] A review of the scientific literature [21] revealed that the trichothecenes had physical and chemical properties ideal for chemical agents; that they could easily be mass-produced; and, also, that they had been the subjects of intense Soviet scientific investigation since the 1930s. (b)(3)

155. For these and other reasons, the decision was made to test for the trichothecenes using the most sensitive and specific methods of analysis available.

[18] This chapter summarizes annex D, which is a detailed presentation of the investigation undertaken to substantiate the case for use of trichothecene toxins in Southeast Asia. (b)(3)

[19] A compilation of the signs and symptoms reported in each country is found in table D-1, annex D. (b)(3)

[20] See annex E. (b)(3)

[21] See annex D, sections IV and V. (b)(3)

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Samples were submitted on a blind basis to Dr. Chester Mirocha, the leading US expert on detection of trichothecenes.

156. ***Results.*** Analyses of four alleged chemical warfare samples (two from Laos and two from Kampuchea) were completed in September 1981. All four showed the presence of extremely high levels of trichothecenes.[22] The samples were collected from the sites of three separate chemical attacks in which victims reported symptoms consistent with trichothecene poisoning. The extremely high levels of toxins found in these samples (150 parts per million of T-2 toxin, 109 ppm of nivalenol, more than 100 ppm of diacetoxyscirpenol, and 66 ppm of deoxynivalenol) have not been reported to occur in a natural environment even under climatic and substrate conditions favorable for their production. Three of the analyzed samples were taken from environments—the surface of rocks or water—that would be extremely unlikely to support natural growth and toxin production.[23]

157. ***Conclusions.*** When all the factors are considered it is clear that the appearance of these particular toxins in these extremely high levels in environments so hostile to their formation cannot reasonably and scientifically be attributed to a natural contamination. This conclusion is supported by the results of the analyses of controls consisting of vegetation, soil, and water samples from an area adjacent to the Kampuchean attack site. Nivalenol, deoxynivalenol, T-2, and diacetoxyscirpenol were not present—indicating that these toxins do not occur naturally in that geographical area. Even samples of corn and rice from the area—which would provide an ideal substrate for the toxin-producing species—were found to be negative for the trichothecenes.

158. Additional alleged chemical warfare samples, including blood samples from victims of "yellow rain" attacks in Kampuchea were analyzed.[24] Preliminary results on these blood samples are consistent with toxin exposure, but are statistically inconclusive because of the problems encountered in obtaining fresh samples and because of the lack of sufficient controls. HT-2, a metabolite of T-2 toxin, was detected in blood specimens from two victims of a "yellow rain" attack.[25] (b)(3)

159. ***Further Efforts.*** Collection efforts continue and additional samples continue to arrive. These will be tested for the trichothecenes as well as for other more familiar chemical warfare agents. In addition, many of the samples previously collected and tested for the traditional chemical warfare agents will be reexamined for the presence of trichothecenes.

Natural Occurrence and Significant Properties

160. The trichothecenes are mycotoxins; that is, they are toxins produced by fungi. There are more than 40 structural derivatives known to occur naturally.[26] Trichothecene toxins, more than any other group of mycotoxins, have been associated with acute disease outbreaks in humans; and most of these outbreaks have occurred in the Soviet Union.[27] The Soviets have traditionally had a strong scientific interest in these toxins, and research projects concerning them have been identified with Soviet institutes believed to be involved in classified research related to chemical and bacteriological warfare.

161. Literature concerned with the natural occurrence of these toxins has been relatively scarce because of the lack of convenient detection methods and the complexity of the trichothecene family of compounds. Methods capable of distinguishing between close structural derivatives and of accurately quantifying the levels of toxin present have only recently become available. We do have reports of natural occurrences of T-2 toxin, diacetoxyscirpenol, deoxynivalenol, and nivalenol—reports that were obtained from a literature search of over 3,000 citations concerned with trichothecene toxins.[28]

162. The extremely high levels of toxins found in the CW samples from Laos and Kampuchea, as noted

[22] See annex D, table D-2.

[23] A detailed analysis of the possibility that the levels of toxins found in the Laotian and Kampuchean samples could have been the result of a natural contamination is presented in annex D, section III.

[24] See annex D, table D-3.

[25] These results are detailed in table D-2, annex D.

[26] Some of the most important of these and the fungi that produce them are listed in table D-4, annex D.

[27] See annex D, table D-5.

[28] These reports are listed in annex D, section IV.

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in paragraph 156, have not been reported to occur in nature. Higher levels of toxin production can, of course, be induced when the mold species is grown in pure culture under ideal temperature and substrate conditions in the laboratory. The Soviets, for instance, have succeeded in producing 4 grams of T-2 per kilogram of substrate under controlled conditions. In a natural environment, however, the *Fusarium* species cannot compete well with other mold species such as *Aspergillus* and *Penicillium*, and levels of toxin produced are lower (in most cases, by several orders of magnitude) than those found in the samples.[29] Several other lines of evidence—including climatic requirements for toxin production, results of surveys of toxigenic fungi in Southeast Asia, and results of controlled studies—support the conclusion that it is impossible to provide a scientifically sound explanation for the natural appearance of these particular toxins at these levels and combinations in an environment so hostile to their production.

163. When one considers the suitability of trichothecenes as chemical agents, factors such as stability, solubility, and ease of production become extremely important. The trichothecenes are very stable and can be stored for years at room temperature with no loss of activity. They are also heat stable, showing no loss of activity after heating at 100 degrees Celsius for an hour. The structure of the compounds allows solubilization of them in a wide range of solvents without affecting the basic toxicity.[30] Although some of the trichothecenes have been synthesized chemically, biosynthesis employing *Fusaria* species is the most effective way to produce large quantities. Almost half of the Soviet open literature concerning these toxins deals with defining optimum conditions for biosynthesis of the compounds.[31]

164. Mycotoxins can be produced in excellent yields employing the same techniques that are used to produce some antibiotics. Both are products of mold metabolism, and an antibiotics installation could provide an excellent cover for agent production facilities. Heavily guarded industrial microbiology plants under military control have been identified in the Soviet Union.

[29] See annex D, table D-7.

[30] See annex D.

[31] See annex D for a representative bibliography.

165. On the basis of their stability, solubility, and production characteristics, the trichothecenes would fit the general requirements for chemical agents. Of course, the most important properties of chemical agents are their toxicological effects.[32] Striking among those for trichothecene toxins are the rapid onset of vomiting and severe itching and tingling of the skin. Hemorrhage of the mucous membranes and bloody diarrhea follow. The correlation between the symptoms reported to have been caused by the trichothecenes and those reported by gas victims in Laos, Kampuchea, and Afghanistan is immediately apparent. (b)(3)

166. Most of the available data concerning the effects of the trichothecenes are the result of animal studies in which pure compounds were administered by oral, subcutaneous, intraperitoneal, or intravenous routes. There are no reports concerning inhalation of mixtures of these compounds. It is difficult, therefore, to speculate concerning the time course and severity of the effects that would be expected in humans exposed to aerosolized mixtures of these potent toxins.[33] (b)(3) (b)(3)

167. The most useful data concerning exposure in humans were obtained in a Phase I clinical evaluation of anguidine (diacetoxyscirpenol) as an experimental anticancer drug. The trichothecene was administered by intravenous infusion, and immediately caused nausea, vomiting, diarrhea, somnolence (and/or mental confusion), fever, chills, a generalized erythema with a burning sensation, hypotension, dyspnea, stomatitis, hives, and ataxia. Another useful body of clinical data concerning the effects of trichothecenes in humans is drawn from descriptions of the course of the disease in the natural outbreaks that occurred in the Soviet Union.[34] (b)(3)

VI. ORIGINS AND EVOLUTION OF THE SOVIET CHEMICAL WARFARE PROGRAM

168. Indications of current chemical weapons used by the Soviets or their allies are more credible when viewed in the context of developments in chemical

[32] The most prominent symptoms associated with trichothecene poisoning are listed in annex D, table D-1. (b)(3)

[33] See annex D, table D-1. (b)(3)

[34] These symptoms are described in detail in annex D, section III. (b)(3)

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weaponry generally and of Soviet association with a given development in particular. The modern history of toxic chemical agents dates from World War I. Both the French and the Germans first used lacrimators on a limited scale in 1914. In an attempt to overcome a stalemate, the Germans on 22 April 1915 launched a large-scale chemical warfare attack: chlorine gas was released from commercial cylinders along the front, with the wind blowing in the direction of the unprepared enemy. This attack was highly effective, and the tactic was subsequently repeated.

169. The first chemical shell, developed by the French and used in early 1916 against the Germans, was filled with phosgene (CG). It was succeeded a short time later by shells filled with hydrogen cyanide (AC). In July 1917 the Germans began using shells filled with mustard gas (HD). About the same time the Germans also introduced diphenylchloroarsine (DA), a particulate irritant that could penetrate the protective masks then in use by the Allied troops.

170. Throughout this war both the Allies and the Germans explored the military effectiveness of chemical munitions of varying sorts. The Russians apparently suffered particularly heavy casualties. By 1917 they had produced the Shlem respirator, an effective protective mask. Even so, Russian soldiers continued to suffer heavy casualties, in part because of lack of training. In one particular attack, for example, the Russian soldiers apparently donned their masks but had not been told to remove the plug from the filter canister. The result was that they were either asphyxiated or died from exposure to the gas when they removed the mask.

171. At the close of the war, the Soviet military establishment examined its experience with chemical weapons and reached the following conclusions: (1) It is necessary to be able to retaliate in kind. During the war the Russian forces failed in this totally; only a small portion of total CW agent use was Russian. (2) It is necessary to understand how to use chemical weapons effectively. (3) It is necessary to have protective equipment available to the troops, and they must know how to use it correctly.

172. To rectify these deficiencies the Soviets became involved in all aspects of chemical warfare. The first Soviet military chemical academies were founded, and the Soviets in 1924 negotiated a CW cooperation pact with the Germans. This pact resulted in establishment of the CW proving grounds at Shikhany. The Germans continued their assistance into 1929, when they departed at Soviet request, abandoning all equipment. In that year the Soviets were field-testing mustard thickened with various additives for use in aerial spray tanks. (b)(3)

173. In 1925 the Geneva Protocol was signed by the United Kingdom, France, Germany, and the USSR. In short, this pact prohibited the first use in war of asphyxiating or deleterious gases; the rights to retaliate and to use such gases against nonsignatories were reserved. (b)(3) (b)(3)

174. During the 1930s the Soviets established a large number of CW production plants and began stockpiling agents. They carried out many field test programs, often involving large numbers of animals. They conducted research into new agents, including experiments with phosgene oxime and with mixtures of agents. They built special railcars to transport bulk agents to sites for filling munition systems. They developed the first ARS decontamination vehicles, which could also be used for carrying bulk agents. All Soviet troops were issued Shlem respirators and protective capes and buskins. By the start of World War II the USSR chemical agent stockpile exceeded 140,000 tons: CW agents were the only war supplies the Soviets did not need from the West. (b)(3) (b)(3)

175. Also during this decade the Germans developed nerve agents, and in 1939 began production of the nerve agent tabun (GA). In 1935 and 1936, Italy successfully employed mustard gas in Ethiopia, claiming that the Geneva Protocol did not prohibit use of CW in reprisal against other illegal acts of war. (b)(3) (b)(3)

176. At the outbreak of World War II the United States, like the Soviet Union, had large stockpiles of mustard and phosgene; and the Germans had stockpiled sulfur mustard, nitrogen mustard, and tabun. Toxic chemicals were not used in that war, however, possibly because of the inhibiting effect of probable retaliation in kind. (b)(3)

177. In 1945 the Soviets captured the German nerve agent plant at Dyhernfurth, together with many

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of its scientists and technicians. The entire plant was transferred to Volgograd. The Soviets first produced tabun and then switched to production of the nerve agents sarin and soman as the agents of choice. A new agent, VR-55, noted by the early 1950s, was subsequently identified as thickened soman, a modification developed by the British and shared with the Soviets during World War II. It has been suggested that chemical warfare was then viewed by the Soviets as a cheap answer to American possession of nuclear weapons. By the late 1950s good intelligence was available on the existence of Soviet weapon systems for CW agents and of plans for their use, as well as details establishing a commitment to training troops in use of and protection from chemical weapons. Production plants were constructed at Shikhany and Dzerzhinsk during the 1960s

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191. In recent years HUMINT reporting has reflected a continuing Soviet commitment to chemical

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defense training, and intelligence from all sources shows protective and decontamination equipment in large amounts and variety. Activity at Soviet CW-related sites has not been affected by US termination of CW agent production. The Soviets have condemned US interest in binary chemical munitions while pursuing similar research. There continues to be evidence that they are working to produce penetrating agents that will defeat Western protection systems.

192. The Soviet Union ratified the 1972 convention banning the production and stockpiling of bacteriological and biological agents and toxins and their means of delivery. They also entered into negotiations with the United States to draft a similar treaty to ban chemical weapons. However, Soviet interest in chemical and biological warfare in all its facets continues unabated, a conclusion quite consistent with the allegations arising from Southeast Asia and Afghanistan.

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ANNEX A [1]

TABULATIONS OF REPORTED CHEMICAL WARFARE ATTACKS IN LAOS, KAMPUCHEA, AND AFGHANISTAN

This annex comprises three tables summarizing chronologically, by location, number, and associated deaths, the chemical attacks reported to have occurred in Laos, Kampuchea, and Afghanistan between 1975 and 1981. The tables were compiled from a large volume of intelligence reports on such attacks. Every effort was made to correlate individual allegations with collateral information and to eliminate double counting. The numbers of fatalities shown almost certainly fall short of actual totals because our coverage is inevitably incomplete and many reports failed to provide casualty numbers.

[1] This annex is unclassified.

Table A-1

Laos: Summary of Reported Chemical Attacks and Associated Deaths, 1975-81

Time Period	Area	Attacks [a]	Deaths [b]
Summer 1975	Vientiane	2	25+
Fall 1976	Phou Bia	8	10
	Savannakhet	1	10
Winter 1976-77	Phou Bia	2	16
Spring 1977	Phou Bia	6	66+
	Khammouan	2	1
Summer 1977	Phou Bia	6	95
Fall 1977	Phou Bia	1	25
Winter 1977-78	Phou Bia	10	1,328+
	Savannakhet	6	224
Spring 1978	Phou Bia	34	969+
Summer 1978	Phou Bia	22	664+
Fall 1978	Phou Bia	19	572
Winter 1978-79	Phou Bia	5	15+
Spring 1979	Phou Bia	36	257+
Summer 1979	Phou Bia	5	239+
Fall 1979	Phou Bia	10	56
	Xaignabouri	2	24+
Winter 1979-80	Phou Bia	4	10+
Spring 1980	Phou Bia	3	24
Summer 1980	Phou Bia	6	187+
Fall 1980	Xaignabouri	1	12
	Phou Bia	7	88+
	Savannakhet	3	1+
Winter 1980-81	Xaignabouri	2	57
	Phou Bia	4	82
	Vientiane	1	1+
Spring 1981	Houaphan	2	?
	Phou Bia	7	218
	Vientiane	1	—
Summer 1981	Phou Bia	1	?
Fall 1981	Phou Bia	4	500+
	Khammouan	3	534+
		226	6,310+

[a] This tabulation omits 35 attacks, accounting for 194 deaths, that were not located in the reports. The totals overall were 261 attacks and more than 6,504 deaths.

[b] A plus sign indicates that the report(s) of deaths gave a minimum figure. In some cases (shown with a question mark) deaths were reported but no number was given. Other reports (signified with a dash) gave no information on fatalities.

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Table A-2

Kampuchea: Summary of Reported Chemical Attacks and Associated Deaths, 1978-81

Time Period	Area	Attacks	Deaths [a]
1978	Ratanakiri	5	?
Summer 1979	Kampong Speu	4	37
Fall 1979	Siem Reap	1	—
	Battambang	4	22+
	Pursat	2	1+
	Koh Kong	2	6+
	Kampot	1	3
	Kampong Chhnang	2	118
Winter 1979-80	Battambang	12	64+
	Pursat	5	21+
	Koh Kong	2	4
Spring 1980	Battambang	3	20+
	Pursat	8	24+
	Koh Kong	5	13
Summer 1980	Siem Reap	1	82+
	Battambang	3	23+
	Pursat	2	7
	Koh Kong	3	—
Winter 1980-81	Battambang	8	—
	Pursat	2	3
Spring 1981	Preah Vihear	1	—
	Battambang	12	163+
	Pursat	3	42+
	Koh Kong	1	—
	Kampot	1	—
Summer 1981	Battambang	3	7+
	Kampong Thom/Cham	1	—
Fall 1981	Siem Reap	16	305
	Battambang	6	16
	Pursat	3	—
	Koh Kong	1	—
	Kampot	1	—
		124	981

[a] A plus sign indicates that the report(s) of deaths gave a minimum figure. In some cases (shown with a question mark) deaths were reported but no number was given. Other reports (signified with a dash) gave no information on fatalities.

Table A-3

Afghanistan: Summary of Reported Chemical Attacks and Associated Deaths, 1979-81

Time Period	Province	Attacks [a]	Deaths [b]
Summer 1979	Badakhshan	1	2,000 [c]
	Parvan	1	8
	Bamian	1	—
Fall 1979	Konarha	1	350
	Farah	1	?
	Herat	1	?
	Badghisat	1	?
Winter 1979-80	Badakhshan	5	130+
	Takhar	1	—
	Konarha	2	10+
	Nangarhar	1	?
	Bamian	1	?
Spring 1980	Badakshan	1	1+
	Konarha	2	?
	Oruzgan	1	—
	Qandahar	1	—
Summer 1980	Nangarhar	2	1
	Vardak	1	3
	Herat	2	300+
	Kabul	2	—
Fall 1980	Konarha	1	?
	Lowgar	1	4
	Ghazni	1	100
Winter 1980-81	Lowgar	2	?
Spring 1981	Parvan	2	—
	Lowgar	3	—
	Ghazni	2	?
	Qandahar	1	—
Summer 1981	Nangarhar	2	?
	Qandahar	2	16
	Herat	1	119
		47	3,042

[a] This tabulation omits some attacks described in the text because they could not be dated or located with high confidence.

[b] A plus sign indicates that the report(s) of deaths gave a minimum figure. In some cases (shown with a question mark) deaths were reported but no number was given. Other reports (signified with a dash) gave no information on fatalities.

[c] The reported figure of 2,000 deaths in Badakhshan after a single attack in the summer of 1979 is unusually high. We are concerned that the figure may reflect an unverifiable reporting error. In all other respects, however, the report met the criteria established for inclusion in this table.

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ANNEX B [1]

COLLECTION AND ANALYSIS OF SAMPLES OF CHEMICAL WARFARE AGENTS AND TOXINS

The specific chemical agents being used in Laos, Kampuchea, and Afghanistan cannot be determined without collection and analysis of at least one of the following: environmental samples contaminated with agent, the munitions used to deliver agents, or biological specimens from attack victims.

Obtaining contaminated samples that will yield positive traces of specific chemical agents is dependent on a number of factors. These include the persistency of the chemical, the ambient temperature, rainfall, wind conditions, the media on which the chemical was deposited, and the time, care, and packaging of the sample from collection to analysis in a laboratory. Many standard chemical warfare agents are nonpersistent and disappear from the environment within a few minutes to several hours after being dispersed. These include, for example, the nerve agents sarin and tabun, the blood agents hydrogen cyanide and cyanogen chloride, the choking agents phosgene and diphosgene, and the urticant phosgene oxime. Other standard CW agents—such as the nerve agents VX and thickened soman and the blistering agents sulfur mustard, nitrogen mustard, and lewisite—may persist for several days to weeks depending on weather conditions. The trichothecene toxins have good persistency but may be diluted to below detectable concentrations by adverse weather conditions. To maximize the chances of detection, sample collections should be made as rapidly after a chemical assault as possible, and with many agents this means minutes to hours. Under the circumstances of Southeast Asia and Afghanistan this has simply not been possible. While numerous samples were collected, few of them held any realistic prospect for yielding positive results. It is fortunate that trichothecenes are sufficiently persistent to allow detection several months after the attack.

Samples have been collected from Southeast Asia since mid-1979 and from Afghanistan since May 1980. To date about 50 individual samples—of greatly varying types and usefulness for analytical purposes—have been collected and analyzed for the presence of traditional CW agents, none of which have been detected. On the basis of recommendations by medical and toxicological experts and of findings by the US Army Chemical Systems Laboratory (USACSL), many of the samples have been analyzed for the trichothecene group of mycotoxins. Four samples, two from Kampuchea and two from Laos, were found to contain high levels of trichothecene toxins. Preliminary results of several additional samples indicate the presence of a trichothecene metabolite in blood samples drawn from Democratic Kampuchea (DK) troops. Quantification of their levels is pending. Details concerning the samples, including the circumstances of their collection, analysis, and the results, are provided in this annex.[2]

All samples were sent to USACSL for analysis, unless otherwise stated. USACSL analyzed all samples for the presence of traditionally recognized chemical warfare agents. Analyses for tricothecenes were conducted by Dr. Chester Mirocha, University of Minnesota, under the sponsorship of the US Army Medical Information and Intelligence Agency (USAMIIA). An independent laboratory in the United States analyzed a few samples for presence of chemical warfare agents.

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[2] See the tables on the ensuing pages.

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Table B-1

Laos: Sample Collection and Analysis for Presence of Chemical Warfare Agents

Sample No.	Sample Description	History of Sample	Analytical Results
1	Polyethylene plastic sheet, 4 square inches	Collected in early 1979 after a chemical attack on H'Mong village. H'Mong refugee gave to Thai personnel, who in turn passed a small piece to US officials for analysis.	Thai preliminary analysis indicated the presence of a vesicant (blistering agent). Analysis by an independent US laboratory found no evidence of vesicant or any other CW agent.
2	Yellow powder residue on bamboo thatching from roof of hut.	Chemical was sprayed from L-19 aircraft in Pha Mai village in March 1979. All animals in village died. At least 28 people died after vomiting blood, coughing up blood, and suffering massive nosebleed, blurred vision, and difficult breathing. Dried yellow spots on bamboo thatching were about 2.0 millimeters in diameter. Sample given to US Army medical team in October 1979. Analyzed by US Army Chemical Systems Laboratory (USACSL).	Total sample of yellow material on bark was 2 milligrams. No evidence of known chemical warfare agents was present. Lauryl alcohol derivatives, primarily sulfate, indicating a possible surfactant or wetting agent for spreading other chemicals was detected.
3	Human tissue samples from 20 H'Mong reportedly exposed to a CW attack and hospitalized in Bangkok. Twenty urine, 19 blood, and 20 sputum samples and 16 chest X-rays were received. Samples from H'Mong refugees not attacked with chemical agents were used as controls.	Samples were taken in July 1980 from H'Mong who had been exposed to a CW attack. Analyzed for cholinesterase. Control samples from H'Mong refugees not exposed to a CW agent were also analyzed. Samples being retained at USACSL for possible additional analysis.	Cholinesterase activity determinations in the blood of exposed individuals were not significantly different from normal/unexposed persons. Cholinesterase activity was very low in both test and control subjects. No evidence of known CW agents in any of the samples.
4	Yellow/orange powder from chemical attack in vicinity of Phou Bia.	Collected by H'Mong resistance fighter, [redacted] on day of attack, 25 October 1980. Thirty of 100 people became ill; none died. Given on 21 April 1981 to medical officer of an international organization, who transferred it to US custody. Sample sent to United States 30 April 1981. Container was not opened until received at USACSL.	No evidence of any known CW agent. (Sample contained only 1 to 2 milligrams of powder.) Not analyzed for trichothecene toxins. Tentatively identified a sesquiterpene, which may be indicative of trichothecenes. Also found were a quinone and aromatic hydrocarbons and carbonyls. (b)(1) (b)(3)
5	Yellow powder residue scraped from a banana leaf in vicinity of Ban Don.	Collected by H'Mong refugee, [redacted] after a 1 April 1981 attack on north side of mountain near Ban Don. Sample received by medical doctor from international organization on 21 April 1981 and by US personnel on 30 April 1981. Container was not opened until received at USACSL.	No evidence of any known CW agent. Sample contained only 1 to 2 milligrams of powder. Not analyzed for trichothecene toxins. Analysis did detect sesquiterpene and carbonyl groups which could be indicative of a trichothecene. (b)(1) (b)(1) (b)(3)

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Table B-1 (Continued)

Laos: Sample Collection and Analysis for Presence of Chemical Warfare Agents

6	Yellow powder (about 350 milligrams) from village of Muong Cha in the Phou Bia region.	H'Mong refugee collected sample by scraping from rocks and leaves after a 13 March 1981 attack in the village of Muong Cha. Refugee arrived in Thailand on 28 April 1981 and gave sample to Thai police authorities, who turned it over to US Embassy officer. Sample forwarded to US on 21 May 1981. Analyzed for known CW agents at USACSL, then transferred to independent laboratory for trichothecene analysis.	No evidence of known CW agent. Aromatic hydrocarbons and carbonyls were present, indicating possible trichothecene. Portion of sample analyzed for mycotoxins of the trichothecene group. T-2 toxin and diacetoxyscirpenol (DAS) were found at levels of 150 and 25 parts per million, respectively. Nivalenol and deoxynivalenol were not detected. Second analysis of sample showed a T-2 toxin level of 143 ppm and DAS at 27 ppm. No nivalenol or deoxynivalenol was detected.
7	Very small amount, less than milligram of solid in 5 milliliters of solution.	First sample taken by a H'Mong from site of a CW attack that occurred on 2 April 1981 at Ban Thong Hak. Twenty-four victims died. Sample was given to a journalist who transferred it to a Congressman. It was given subsequently to USACSL on 11 June 1981. Sample transferred to USAMIIA for analysis for trichothecene toxins. Second sample from same channel received on 30 June 1981.	Sample 1: No evidence of any traditional CW agents. Solvent was methanol. No T-2, nivalenol, or deoxynivalenol was present. Ten nanograms of diacetoxyscirpenol (DAS), a toxic trichothecene, were present in the sample. The small sample size precluded adequate analysis for other trichothecene toxins, and it cannot be determined if they were present or not. Sample 2: Indications of a steroid which could be indicative of a trichothecene. No evidence of known CW agents.
8	Five blood samples	Samples were clotted. Sent to USAMIIA on 17 November 1981. No analysis for trichothecene toxins planned. Symptoms described by victims indicate that the chemical agent was CS or other riot control material.	No exploitation at this time.
9	Two samples: — Natural vegetation, stem and leaves. — Plastic bottle containing five samples, three of leaves and two of powder.	Sample of residue collected after a 6 December 1981 CW attack at Muong Phon, 20 kilometers west of Phou Bia. Victims suffered from bloody vomiting and diarrhea. Many deaths. H'Mong carried the sample out of Laos 8 December 1981. [redacted] received it 9 December 1981 and provided sample to Embassy. Received by USACSL on 5 January 1982. One-fourth of sample given to UK for analysis. One-fourth sample to USAMIIA for trichothecene analysis.	Sample 1: No evidence of known CW agents. Analysis incomplete. Sample 2: No evidence of known CW agents. Identified 2 methylfuran, cyclooctatetraene which could be indicative of a trichothecene. Analysis incomplete. (b)(1) (b)(3)
10	Residue	Sample collected by a H'Mong resistance leader immediately after a 12 December 1981 CW attack. Villagers suffered bloody diarrhea, some deaths. Sample given to Embassy official on 8 January 1982 and transferred to UK officials on that date. Sent to London on 19 January for analysis.	

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Table B-2

Kampuchea: Sample Collection and Analysis for Presence of Chemical Warfare Agents

Sample No.	Sample Description	History of Sample	Analytical Results
1	Clothing (two pair of trousers, two shirts) from dead Democratic Kampuchea (DK) soldier	On 27 February 1980 a US Embassy officer obtained clothing sealed in heavy plastic bags from Thai official. Clothing reportedly taken from DK soldiers killed in chemical attack in the Pailin area. Clothing sample was obtained two weeks before being given to US officer. Analysis done by an independent laboratory.	No evidence of standard CW agents was detected. Not analyzed for mycotoxins. Cytotoxicity tests were negative.
2	Water sample (25 milliliters)	Sample taken in mid-January 1980 from a stream in the Thaphaya area of the Thai-Kampuchean border by Royal Thai Army (RTA) troops. It was passed to station officer by Thai who claimed that RTA troops and villagers became ill with swelling limbs and a red rash. Analyzed by independent laboratory.	No evidence of standard CW agents was detected. Not analyzed for mycotoxins. Cytotoxicity tests were negative.
3	Red corn (500 grams). Corn contained cob particles, broken kernels, and insects.	Sample obtained from Kampuchean refugee who entered Thailand in early 1980. The corn was provided by the Vietnamese and reportedly originated in Russia. Eating it caused people to vomit and cough up blood. Analyzed by independent US laboratory.	No evidence of known CW agents. Was not toxic to cell tissue culture. No toxic effect noted in rat receiving portion of sample orally. Not analyzed for trichothecene toxins.
4	Empty artillery shell	Sample collected by DK refugee in early 1980. Received 5 May 1980. Sent to independent laboratory for analysis.	No evidence of presence of CW agents or their degradation products. Major constituent was TNT.
5	Shirt taken from DK victim of CW attack.	Attack occurred on 29 February 1980 about 15 to 20 kilometers southeast of Nong Pru. Victim reported symptoms of nausea, vomiting, weakness, and headache. Some victims reportedly died from internal bleeding. On 5 March 1980, RTA officer in Aranyaprathet delivered the garment sealed in a foil bag to a US Embassy officer. Sample was pouched to USACSL on 7 March 1980.	No evidence of any standard CW agent or agent breakdown product was detected on the sample. Two siloxanes (hexamethylcyclotrisiloxane and octamethyltetrasiloxane) were identified. These are of interest because of the intensive studies of siloxanes by Soviet scientists. The presence of a component with a mass of 100 was detected but not identified. No unusual effects were noted in mice confined with the clothing for six hours. Biocultures proved negative.

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Table B-2 (Continued)

Kampuchea: Sample Collection and Analysis for Presence of Chemical Warfare Agents

Sample No.	Sample Description	History of Sample	Analytical Results
6	Yellow corn packaged in plastic bag.	Obtained from Kampuchean refugee. Received by USACSL on 19 November 1979.	Arsenic was detected at a level of 43 ppm. Arsenic appears to be organically bound, but is not in a known CW agent structure.
7 [a]	Water sample from area of CW attack.	Sample given to US Embassy officer by Thai chemical officer who acquired it on the Thai-Kampuchean border area near Phnom Mak Hoeum about 15 March 1981. Sample received by USACSL on 25 March 1981. Sample given to USAMIIA on 26 August 1981 for trichothecene analysis by independent laboratory.	Cyanide at 460 ppm. (Note: control water samples also contained high cyanide levels.) No evidence of standrd CW agents was detected. Analysis for toxins revealed presence of deoxynivalenol at level of 66 ppm. Trace of another trichothecene toxin, diacetoxyscirpenol (DAS), also found.
8 [a]	Leaves and stem samples.	Sample obtained by Thai chemical officer about 15 March 1981 on Thai-Kampuchean border just south of Phnom Mak Hoeum. Given to US Embassy officer, who sent it to USACSL. Received on 24 March 1981. Transferred to USAMIIA on 29 April 1981 for trichothecene analysis by independent laboratory.	Sample was positive for cyanide (8.7 mg/leaf) and a trace of fluoride. No evidence of standard CW agents. Sample contained three trichothecene toxins: T-2 at 3.15 ppm, nivalenol at 109 ppm, and deoxynivalenol at 59.1 ppm.
9	Water samples	Six water samples reportedly from area of chemical attack were given to Embassy personnel by Thai officer who received them from DK sources. Collected 15 March 1981. Received by USACSL on 24 March 1981.	No evidence of standard CW agents. Not yet analyzed for toxins. Cyanide was found at levels between 210 and 590 ppm. (Note: Cyanide also found in control water samples.)
10	Negative control samples of water, soil, vegetation, corn, and rice.	Received from field on 20 September 1981.	Analyzed for toxins. Negative results on all samples.
11	Blood samples (A14, A15, A16, and A17.)	Four samples were drawn from DK personnel exposed to CW agent on 19 September 1981. Samples drawn on 7 October 1981. Samples were left unrefrigerated for 48 hours after collection and had begun to putrify, which interferes with many assays. Sent to USAMIIA for analysis for trichothecenes at an independent laboratory.	Negative results on all samples. Samples were in poor condition for analysis.
12	Blood samples and blood smears. Total blood samples: 13 (B-1 through B-13)	Nine blood samples from DK personnel who had been subjected to a CW attack in fall 1981. Approximately 50 people were killed in the attack. Four samples from unexposed DK personnel. Samples drawn on 21 October 1981 by trained medical personnel. Sent to USAMIIA for analysis on 22 October 1981. Samples properly refrigerated and in good condition for analysis.	White blood cell count (WBC) was low in all victims but not significantly lower than in nonexposed individuals. A metabolite of T-2 toxin (HT-2) was tentatively identified in the blood of two victims having the lowest WBCs.

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Table B-2 (Continued)

Kampuchea: Sample Collection and Analysis for Presence of Chemical Warfare Agents

Sample No.	Sample Description	History of Sample	Analytical Results
13	Two samples: — Bottle with leaves reportedly contaminated with powder CW agent. — Bottle with small piece of bamboo reportedly contaminated with toxic agent.	Powder spread by airplane over upper Koh Kong Province. Exposed individuals vomited blood. Also some deaths. Attack took place on 10 November 1981. Samples were given to Embassy contacts by DK escape representative in Bangkok on 12 November 1981. Sent 16 November 1981 in diplomatic pouch. Received by USACSL on 19 November. Portion of sample transferred to USAMIIA for trichothecene analysis.	Analysis in progress.
14	Glass bottle containing a powder, tinted pink.	Powder was obtained on 20 November 1981 by KPNLF (Khmer People's National Liberation Front) forces in Kampuchea. Received by USACSL on 8 December 1981. Portion of sample transferred to USAMIIA on 16 December 1981 for trichothecene analysis.	Sample is 98-percent talc. Other chemicals not identified. Analysis for trichothecenes incomplete.

[a] Control samples collected outside range of chemical attack did not contain any trichothecene toxins or known CW agents.

Table B-3

Afghanistan: Sample Collection and Analysis for Presence of Chemical Warfare Agents

Sample No.	Sample Description	History of Sample	Analytical Results
1	Rocket and bomb fragments with Soviet markings.	Fragments were obtained in Konarha Province. Sent to USACSL on 18 April 1980.	No evidence of standard CW agents.
2	Soviet gas mask and canister.	Purchased in Kabul. Sent to USACSL 18 September 1980.	No evidence of standard CW agents. Dioctylphthalate, which probably was used to test gas mask filter, was identified.
3	Knit polyester cap, a polyester knit jacket, badly worn shirt, which appeared to be recently washed.	Obtained in Islamabad, Pakistan, from an Afghan refugee, who claimed he was subjected to a gas attack. Collected on 2 November 1980; shipped from field on 19 November 1980; received by CSL 8 December 1980.	No evidence of any known CW agent. Detected a high molecular weight ester and adipic acid esters which could be indicative of a trichothecene. Also detected malathion.
4	Human tissue (2 bottles)	Same as 3.	Not analyzed because of sample deterioration en route.
5	7.62-mm cartridges.	The cartridges, which reputedly were coated with a poison, were carried by special Afghan police and some Soviet advisers. Samples were collected in November 1980 and received for analysis at USACSL on 4 February 1981.	No evidence of standard CW agents was found on bullet coating or scrapings from slug. Not analyzed for toxins.

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Table B-3 (Continued)

Afghanistan: Sample Collection and Analysis for Presence of Chemical Warfare Agents

Sample No.	Sample Description	History of Sample	Analytical Results
6	Cotton garment and socks.	Clothing appeared to be very dirty. Clothing obtained from Afghan refugee in Islamabad, Pakistan. Refugee reportedly subjected to CW attack. Received by USACSL 12 February 1981. Transferred to USAMIIA for toxin analysis.	No evidence of known CW agents. Results on trichothecene pending completion of analysis.
7	Soviet Shlem gas masks.	Five masks were procured in Kabul, Afghanistan, at various times and were sent as received to USACSL for analysis between 24 August 1981 and 21 December 1981. No background information is available with these masks.	No evidence of any known CW agents to date.
8	Soviet 5.45-mm cartridge case, expended.	Obtained by Mujahedin about 1980. The bullets had been captured from the Soviets and used by Afghan Islamic insurgents. During a firefight, insurgents using the bullets became ill, with severe vomiting and nausea for several hours. They suspected that Soviets had contaminated the powder charge. Sent to USACSL on 25 August 1981.	No evidence of any generally recognized agent or toxic compound was found. Was not analyzed for toxins.
9	Soviet gas mask with canister.	Item was reportedly taken from a Soviet who was killed during a Soviet gas attack in early 1981. Item was collected by an Afghan, who is associated with the Mujahedin and who loaned the item to US personnel for analysis. USACSL received the mask on 18 December 1981.	Analysis incomplete.
10	Grain	Sample was collected by a reliable source, who reported that it may have been poisoned. USACSL received sample on 24 February 1982. Portion of sample to be analyzed for toxins.	Analysis incomplete.

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ANNEX C [1]

US ARMY SURGEON GENERAL'S INVESTIGATIVE TEAM REPORT

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Use of Chemical Agents Against the H'Mong in Laos

From 28 September to 12 October 1979 a team from the office of the US Surgeon General was in Thailand to investigate allegations of the use of chemical agents against H'Mong tribesmen in Laos.

The team visited the following H'Mong refugee camps in northern Thailand: the detention center at Nhong Khai; the large H'Mong camp at Ban Vanai; and two smaller camps at Nam Yao and Mae Charmin. As the great majority of refugees as well as the H'Mong leadership are at Ban Vanai, most of the interviews were obtained there.

Entrance and exit briefings concerning the team's mission were held at the US Army Biomedical Laboratory, Aberdeen Proving Ground; the State Department, Washington; and the US Embassy, Bangkok; and with the Thai Army Surgeon General; refugee camp officials; and the US Army Surgeon General and Assistant Chief of Staff for Intelligence.

The team was prepared to obtain blood and skin samples (for cholinesterase activity and study of pathological changes, respectively) from those exposed to chemical agents. For such samples to yield meaningful results they must be taken within six to eight weeks of exposure. Since the last reported exposure was in May 1979, no samples were collected.

Interviews were conducted through interpreters; one interpreter was an employee of the US Consulate at Udorn, and the remainder were hired from among the refugees. The interpreters screened those refugees who volunteered to talk to the team and selected only those who had been eyewitnesses to or had themselves been exposed to an agent attack. Team members interviewed 40 men, two women, and a 12-year-old girl. Each interview took one to two hours. To achieve conformity a prepared questionnaire was used as a guide.

The chemical attacks reportedly occurred between June 1976 and May 1979 (table C-1). The absence of reports of attacks after May 1979 may be because very few refugees crossed the Mekong River after that time because of heavy rains and flooding from June to September 1979. Most of the early reports were of the use of rockets releasing the agent, but beginning in the fall of 1978 the majority of the attacks were carried out by aircraft spraying a yellowish substance which "fell like rain." The sites of the attacks, which were concentrated around the H'Mong stronghold in the mountainous Phou Bia area, are also listed in table C-1.

[1] ~~This annex is unclassified.~~

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Table C-1

Reports of Probable Chemical Agent Attacks

Date	Location	Method of Attack	Material Used (Smoke or Gas)
Jun 76	Pou Mat Sao	Plane, rockets	Red and green
Jan 77–Oct 78	Pha Khao	Plane, rockets	Yellow, red, green
Mar 77	Nam Theuna	Plane, rockets	Red and yellow
Apr 77	Houi Kam Lang	Plane, rockets	Yellow
May 77	Pha Khae	Plane, rockets	Red
May 77	Nam Moh	Plane, rockets	Yellow
May 77	Pha Ngune	Biplane, spray	Yellow gas
		Plane, rockets	Yellow
1977-78x3	Phu Seu	Plane, rockets	Red, green, yellow
Jan 78	Houi Xang	Plane, rockets	Red and green
Feb 78	Sane Mak Ku	Plane, rockets	Yellow
Feb 78	Tham Se Sam Lein	Plane, rockets	Yellow and black
Feb 78	Kio Ma Nang	Plane, rockets	Yellow
Mar 78	Mouong Ao	Plane, rockets	White
Mar 78	Khieu Manang	Plane, rockets	Green
Apr 78	Tha Se	Plane, rockets	Yellow
Jun 78	Pha Phay	Plane, rockets	Yellow
Jun 78	Phou Seng	Plane, rockets	Red, white, black
Jul 78	Phou Bia	Plane, rockets	Red
Jul 78	Ban Nam Mo	Plane, spray	Yellow
Jul 78	Phou Lap	Plane, rockets	Yellow
Aug 78	Pha Houai	Plane, rockets	Red and green
Aug 78	Ban Thin On	Plane, rockets	Green and red
Aug 78	Bouam Long	Plane, rockets	Red, green, yellow
Sep 78	Pha Koug	Plane, rockets	Yellow
Sep 78	Ban Nam Tia	Plane, spray/rockets	Yellow, green, red
Sep 78	Pha Na Khum	Plane, rockets	Red
Oct 78	Phou Bia	Plane, rockets	
Oct 78	Ban Done	Plane, spray	Yellow
Oct 78	Phou Bia	Plane, rockets	White, green, red
Nov 78	Phou Chia	Plane, rockets	White, red
Feb 79	Pha Mat	Plane, spray	Yellow
Feb 79	Tong Moei	Plane, rockets	Yellow and red
Mar 79	Pha Mai	Plane, spray	Yellow
Apr–May79x4	Pha Mai	Plane, spray	Gray-white
Mar–May79x6	Pha Mai	Plane, spray	Yellow
May 79	Phou Chia	Plane, spray	Yellow
May 79	Moung Phong	Plane, rockets	Red
		Department of State Interviews	
Oct 77	Phu Hay, S of Phu Bia	Plane (L-19), rockets	Yellow-gray gas
Unk 78	Pa Sieng, S of Phu Bia	Plane, unknown bomb	Yellow cloud
Feb 78	Ban Nam Luk, S of Phu Bia	Planes (L-19), spray (?)	Yellow/white gas
Feb 78	20 km SE of Phu Bia	Plane, unknown spray (?)	Yellow, provided sample
Feb 78	Ban Ko Mai	Plane, unknown bomb	Yellow
Mar 78	Pha Houei	Plane (MIG?), sacks burst in air	Brown gas

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Table C-1 (Continued)

Reports of Probable Chemical Agent Attacks

Date	Location	Method of Attack	Material Used (Smoke or Gas)
Mar 78	Ban Na Pong	Plane (jet?), not described	Yellow
Apr 78	Ban Phamsi	Plane, not described	Green and white cloud
May–Apr 78	Ban Nong Po	Plane (MIG?), cloud	Yellow-brown like rain
Jun 78	Ban Nam Teng	Plane, unknown rocket (?)	Yellow gas
Jun 78–May 79	Ban Don area	Plane (jet?), spray	Yellow rain
Mid-78	1-3 km NE of Phu Bia	Plane, unknown rocket, burst in air	Red gas
Oct 78	Nam Kham	Plane (L-19), rockets, airburst	Yellow cloud
Oct 78	6 km N of Phou Khao	Plane (L-19?), rockets, airburst	Red cloud
Oct 78	3-4 km N of Phu Bia	Plane (L-19?), rockets, airburst	Yellow-gray fog
Nov 78	Phou Xang Noi	Plane (MIG?), spray	Yellow and blue cloud
Nov 78	nr Phu Bia	Plane, unknown bomb, airburst	Yellow substance
Nov 78	NE of Pha Khao	Plane (L-19), rocket, airburst	Yellow gas
Apr 79	Ban Nouia Pong	Plane (MIG?), spray	Yellow clouds
May 79	Nam Po	Plane (jet?), spray	Yellow substance
May 79	Pha Mai	Plane (MIG?), spray, airburst	Yellow substance

The team was given a plastic vial containing pieces of bark stained by a yellow substance which several H'Mong refugees claimed was residue from an aircraft spray attack in April 1979. Preliminary chemical analysis of the sample indicates that no standard chemical agent is present, i.e., an agent listed in TH 8-285 (US Army, May 1974). A complete report of this analysis will be submitted upon completion of further studies.

A similar series of interviews was conducted by State Department officials in June 1979. From the signs/symptoms described and observed the following is suggested:

1. At least two, and possibly three, different chemical agents may have been used, such as:

(a) A nerve agent (five or six individuals reported symptoms that could be attributed to a nerve agent).

(b) An irritant or riot control agent (a third of the interviews).

(c) Over half of the interviews indicated such a variety of signs and symptoms that it is difficult to attribute them to a single known agent.

2. It is possible that, in some cases, two or more agents were combined.

(a) Reported signs and symptoms suggesting a nerve agent include sweating, tearing, excessive salivation, difficulty in breathing, shortness of breath, nausea and vomiting, dizziness, weakness, convulsions, and death occurring shortly after exposure.

(b) Reported signs and symptoms suggesting a riot control or irritant agent include marked irritation or burning of the eyes with tearing and pain; irritation and burning of the nose and throat; coughing, burning, and tightness in the chest; headache; and nausea and vomiting in a few cases.

(c) Reported signs and symptoms not related to any known single agent include a mixture of the above plus the features of profuse bleeding from mucous membranes of the nose, lungs, and gastro-intestinal tract with rapid death of the affected individuals in some instances. Many of these effects were similar to those described in attacks during the war in Yemen.[1]

[1] SIPRI The Problem of Chemical and Biological Warfare, Volume 5, The Prevention of CBW, page 255, Humanities Press, Inc., 300 Park Avenue South, New York, N.Y. 10010.

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Estimates from the H'Mong interviewed indicate that approximately 700 to 1,000 persons may have died as a result of the use of chemical agents, and that many times this number were made ill. It was reported that on numerous occasions entire villages were devastated by these agents, leaving no survivors.

In the episodes described, most of the animals exposed to the chemical agents were killed. Generally, all chickens, dogs, and pigs died and, to a lesser extent, the cattle and buffalo.

On several occasions it was reported that where these agents settled on tree and plant leaves, many small holes appeared in the leaves within two or three days. Rarely did agent exposure result in the defoliation or death of the plants.

Conclusions

The conclusions of the team based upon interviews obtained from H'Mong refugees are as follows:

1. Chemical agents have been used against the H'Mong.
2. The reported effects of these agents suggest the use of a nerve agent, a riot control agent, and an unidentified compound or combination of compounds.

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ANNEX D [1]

ANALYSIS AND REVIEW OF TRICHOTHECENE TOXINS

I. SAMPLE ANALYSES FOR TRICHOTHECENES

The Trichothecene Hypothesis

Since 1976, remarkably consistent reports detailing chemical attacks in Southeast Asia have been received by the Intelligence Community. Some of these reports were of particular interest in that they described the use of lethal agents producing symptoms that could not be correlated with those produced by traditionally recognized chemical warfare agents or combinations of them. Table D-1 is a compilation relating the signs and symptoms reported in Laos, Kampuchea, and Afghanistan with symptoms associated with certain chemical agents. The frequency with which a particular symptom was reported is expressed as a percentage of the total number of attacks.

It is readily apparent that the symptoms most frequently described in Laos and Kampuchea correspond most closely with those produced by a group of mycotoxins, the trichothecenes. A review of the scientific literature revealed not only that these compounds had physical and chemical properties indicating potential as chemical agents, but also that they were the subjects of intensive investigation by Soviet scientists at institutes previously linked with chemical and biological warfare research. In the fall of 1980 the trichothecenes were added to the list of agents suspected to have been used in Southeast Asia and Afghanistan. Other candidates under consideration included phosgene oxime, arsines, cyanogen, nerve agents, riot control agents, and combinations of these agents.

Numerous samples from chemical attacks in Laos and Kampuchea were examined at the Chemical Systems Laboratory (CSL) for the presence of traditional chemical warfare agents and were reported to be negative. In March 1981 CSL reported the presence of an unusual compound ($C_{15}H_{24}$) in the vapor analyses from several clothing and tissue samples taken from the victim of a chemical attack. The compound was very closely related in structure to the simple trichothecenes, and this finding sparked the request for analysis of all future samples for the presence of trichothecene mycotoxins.

The Kampuchean Leaf and Stem Sample—The First Analysis for Trichothecenes

On 24 March 1981 a number of samples from the US Embassy in Bangkok were received. Two of the samples were reported to have been collected from the site of a chemical attack that occurred in the vicinity of TV 3391, an area just south of Phnom Mak Hoeum. A vegetation sample and a water sample were collected within 24 hours of the attack. Examination of bodies of victims of this attack by medical personnel revealed highly unusual degeneration of the mucosal lining of the gastrointestinal tract. The effects described paralleled those known to be produced by the trichothecenes.

The samples were submitted to Chemical Systems Laboratory for analysis for the presence of chemical warfare agents. No evidence of known chemical warfare agents was found. An initial test for the trichothecenes by thin layer chromatography (TLC) was inconclusive because of severe problems with interfering substances and the lack of appropriate standards. The trichothecenes are difficult to detect even under ideal circumstances, and the presence of interfering substances in the sample may make identification and quantitation by TLC inconclusive. A review of the limitations and potentials of analytic methods for trichothecenes led to the conclusion that the computerized gas chromatography/mass spectroscopy method in the selected ion monitoring mode would enable precise identification and quantitation of these com-

[1] This annex is unclassified.

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Table D-1

Symptoms of Chemical Attacks Reported in Laos, Kampuchea, and Afghanistan

Symptom	Percentage of Reports Mentioning Symptom	Tricho-thecenes	Nerve Agents	Arsines	Phosgene Oxime	Cyano-gens	Incapitant	Riot Control Agents
Laos								
Multiple deaths	84.6	X	X	X	—	X	—	—
Vomiting	71.4	X	X	X	—	—	—	X
Diarrhea	53.1	X	X	X	—	—	—	—
Hemorrhage	52.0	X	—	—	X[a]	—	—	—
Breathing difficulty	47.95	X	X	X	X	X	X	X
Itching and skin irritation	43.9	X	—	X	X	—	—	X
Nausea	42.8	X	X	X	—	—	X	X
Animal death	41.8	X	X	X	—	X	—	—
Blurred vision	39.7	X	X	X	X	X	X	X
Headache	36.7	X	X	—	X	—	X	X
Fatigue	35.7	X	X	—	—	—	X	—
Nasal excretion	34.7	X	X	X	X	—	—	X
Rash or blisters	32.6	X	—	X	X	—	—	X
Tearing	30.6	X	X	X	X	X	—	X
Coughing	28.6	X	X	X	X	X	—	X
Effect on Vegetation	26.5	X	—	—	X	—	—	—
Dizziness and vertigo	25.5	X	X	—	—	X	X	X
Facial edema	20.4	X	—	X	X	—	—	X
Thirst and dry mouth	20.4	X	—	—	—	—	X	—
Skin color change	16.3	X	—	—	X	—	—	—
Tachycardia	12.3	X	X	—	X	X	X	X
Temporary blindness	9.18	X	—	X	X	—	X	X
Rapid loss of consciousness	9.18	X[b]	X	—	—	X	X	—
Salivation	6.12	X[c]	X	—	—	—	—	—
Hearing loss	5.1	X	—	—	—	—	—	—
Tremors or convulsions	4	X	X	—	X	X	—	—
Sweating	3	—	X	—	—	—	—	—
Paralysis	3	X	X	—	—	X	—	—
Loss of appetite	3	X	X	X	—	—	—	—
Frequent urination	2	X	X	—	—	—	—	—
Kampuchea								
Multiple deaths	72.4	X	X	X	—	X	—	—
Hemorrhage	62.06	X	—	—	X[d]	—	—	—
Dizziness and vertigo	51.7	X	X	—	—	X	X	X
Vomiting	41.3	X	X	X	—	—	—	X
Nausea	34.5	X	X	X	—	—	X	X
Skin irritation	27.6	X	—	X	X	—	—	X
Rapid loss of consciousness	24.1	X[b]	X	—	—	X	X	—
Fever	20.68	X	—	—	—	—	—	—
Headache	17.2	X	X	—	X	—	X	X
Tearing	13.8	X	X	X	X	X	X	X
Breathing difficulty	13.8	X	X	X	X	X	X	X
Fatigue	13.8	X	X	—	—	—	X	—
Paralysis	10.3	X	X	—	—	X	—	—
Numbness	6.9	X	X	—	—	X	X	—

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Table D-1 (Continued)

Symptoms of Chemical Attacks Reported in Laos, Kampuchea, and Afghanistan

Symptom	Percentage of Reports Mentioning Symptom	Trichothecenes	Nerve Agents	Arsines	Phosgene Oxime	Cyanogens	Incapitant	Riot Control Agents
Blurred vision	6.9	X	X	X	X	X	X	X
Dry throat and thirst	6.9	X	—	—	—	—	X	—
Edema	6.9	X	—	X	X	—	—	—
Salivation	3.4	X[e]	X	—	—	—	—	—
Vegetation affected	3.4	X	—	—	—	—	—	—
Diarrhea	3.4	X	X	X	—	—	—	—
Cough	3.4	X	—	X	X	X	X	X
Nasal discharge	3.4	X	X	X	X	—	—	X
Rash or blister	3.4	X	—	X	X	—	—	X
Chills	3.4	X	—	—	—	—	—	—
Hearing loss	3.4	X	—	—	—	—	—	—
Afghanistan								
Rapid loss of consciousness	47.9	X[b]	X	—	—	X	X	—
Skin irritation and itching	31.5	X	—	X	X	—	—	X
Multiple deaths	30.1	X	X	X	—	X	—	—
Nausea	20.5	X	X	X	—	—	X	X
Vomiting	19.1	X	X	X	—	—	—	X
Tearing	17.8	X	X	X	X	X	—	X
Dizziness and vertigo	16.4	X	X	—	—	X	X	X
Blisters or rash	15	X	—	X	X	—	—	X
Difficulty breathing	13.7	X	X	X	X	X	X	X
Paralysis	13.7	X	X	—	—	X	—	—
Headache	12.3	X	X	—	X	—	X	X
Temporary blindness	8.2	X	—	X	X	—	X	X
Salivation	6.8	X[c]	X	—	—	—	—	—
Loss of appetite	6.8	X	X	X	—	—	—	—
Effects on vegetation	5.5	X	—	—	—	—	—	—
Fatigue	5	X	X	—	—	—	X	—
Confusion	4.1	X	X	—	—	—	X	—
Hemorrhage	4.1	X	—	—	X[a]	—	—	—
Change in skin color	2.8	X	—	—	X	—	—	—
Diarrhea	2.8	X	X	X	—	—	—	—
Coughing	1.3	X	X	X	X	X	X	X

[a] Bloody frothing.
[b] Only at very high doses.
[c] Depending on which trichothecenes.
[d] Blood-flecked frothing.
[e] Depending on compound.

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pounds in complex mixtures. An additional recent publication includes a summary of the currently available methods suitable for trichothecene analysis and an assessment of their utility and limitations.

A portion of the leaf and stem sample was furnished to the US Army for further analysis. This sample (see table D-2, group I/A), a positive control sample to which T-2 toxin was added (group I/B), and a negative control sample of similar vegetation (group I/C) were forwarded to Dr. Chester J. Mirocha, Department of Plant Pathology, University of Minnesota. Dr. Mirocha was given no information concerning the history or content of the samples, and was requested to analyze the three unknowns for the presence of trichothecene toxins using the best methods at his disposal. Briefly, the analysis involves a series of extractions followed by ferric gel separation, selected ion monitoring on a computerized gas chromatograph/mass spectrometer, and a full mass spectral scan for comparison with known standards.

The methods used are among the most sensitive and specific for detection of these compounds; also, false positives are rare. Toxins can be identified by their mass spectra and quantified with a high degree of accuracy. Group I/A—the vegetation sample allegedly exposed to a CW agent—was found to contain 109

Table D-2

Trichothecene Sample Analyses

Reference Number/ Case Number	Code	Date Received	Description	Current Status
Sample Group I/..... M-22-81		29 Apr 81	Leaf and stem + negative control	Analysis complete.
	A		Sample from attack area	Code A sample: T-2 - 3.15 ppm; Nivalenol - 109 ppm; Deoxynivalenol - 59.1 ppm
	B		Positive control (spiked)	Code B sample: T-2 - 35.7 ppm; Nivalenol - 21.7 ppm
	C		External negative control	Code C sample: Negative results
Sample Group II/..... M-23-81		26 Aug 81	Environmental samples	Analysis complete.
	D		Water	Code D sample: Deoxynivalenol - 66 ppm; Diacetoxyscirpenol - Trace
	E [a]		Yellow powder	Code E sample: T-2 - 150 ppm; Diacetoxyscirpenol - about 25 ppm
	F		Speck (unknown substance)	Code F sample: Diacetoxyscirpenol - 10 ng
Sample Group III/..... M-26-81		20 Sep 81	Environmental samples (Negative controls)	Analysis complete.
	A		Water sample	Negative results on all samples tested to date.
	B		Soil sample	
	C		Soil sample	
	D		Dried corn	
	E		Rice	
	F		Leaves and stem	
	G		Leaves and stem	
	H		Leaves and stem	
	I		Leaves and stem	

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Table D-2 (Continued)

Trichothecene Sample Analyses

Reference Number/ Case Number	Code	Date Received	Description	Current Status
Sample Group IV/ M-1-82		5 Oct 81	Environmental samples (Negative controls)	Retained at laboratory pending results of higher priority analyses.
Sample Group V/ M-2-82		11 Oct 81	Blood samples	Analysis complete.
	A14 A15 A16 A17			Negative results on all samples tested to date.
Sample Group VI/ M-3-82		22 Oct 81	Blood samples	Analysis complete. Analytical findings to date have tentatively identified HT-2, a deacetylated metabolite of T-2 toxin, in the blood of patients 3 and 4 (see table D-3).
	A1 . . . A13 B1 . . . . B13			Medical laboratory evaluation of blood samples conducted by US Army Medical Research Institute of Infectious Diseases (USAMRIID). No significant statistical differences between control samples from alleged victims of "yellow rain," but a trend toward low blood cell counts in victims was noted. See table D-3.
Sample Group VII/		17 Nov 81	Blood samples	Retained at laboratory pending completion of higher priority analyses.
Sample Group VIII/ M-8-82		17 Nov 81	Environmental samples	Analysis in progress.
Sample Group IX/ M-9-82		6 Nov 81	Environmental samples (Sock, pants, mask, water)	Analysis in progress.
Sample Group X/ M-11-82		19 Nov 81	Environmental sample	Analysis complete.
	E2		Yellow powder	143 ppm T-2 27 ppm DAS 0 nivalenol 0 deoxynivalenol

[a] Additional 25 mg of this sample was provided to laboratory for analysis for nivalenol and deoxynivalenol (see Sample Group X/M-11-82).

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parts per million (ppm) of nivalenol, 59.1 ppm of deoxynivalenol, and 3.15 ppm f T-2 toxin; each is a potent toxin of the trichothecene group. No trichothecenes were detected in the negative control sample (group I/C), and 35 ppm of T-2 toxin were detected in group I/B—the sample to which T-2 toxin had been added. It was Dr. Mirocha's assessment that a mixture of these particular toxins in the high levels detected could not have occurred as a result of natural contamination.

The possibility that the identified toxins were produced by natural fungal contamination is addressed in section III. In summary, the possibility was discounted on the basis of the climatic conditions required for production of T-2 toxin, the high levels of toxins detected, the unusual mixture of toxins found, and the results of surveys of Southeast Asia for the presence of these toxins. This conclusion was supported by the analysis of normal flora samples from Kampuchea described below.

Analyses of Control Samples From Kampuchea for the Presence of Trichothecenes

On 20 September 1981, nine control samples were received from US Army personnel in Bangkok, Thailand, for the purpose of conducting laboratory analyses for background levels of trichothecene toxins. The samples were collected from an area near TV 3391 that had not been subjected to any reported chemical attacks. The samples were collected by US personnel under instructions to reproduce the sampling conditions, handling, packaging, and transfer conditions of the original sample as closely as possible. The same species of plant was sampled, and three other vegetation samples were also collected. A water sample as well as two soil samples were recovered. Samples of corn and rice from the area were also taken. These grains provide an ideal substrate for growth of toxin-producing fungi and would therefore be a sensitive indicator of any natural occurrence.

The nine samples were forwarded under code to Dr. Mirocha for trichothecene analysis. A portion of each sample was also submitted to CSL for background determinations of CN^-, Cl^-, and Fl^- levels. No trichothecenes were detected in any of these samples (group III/A-I), indicating that nivalenol, deoxynivalenol, T-2, and diacetoxyscirpenol are not prevalent in the geographical area from which the alleged CW-exposed sample was collected. The appearance of these trichothecenes in high levels and unique combinations in a sample associated with a chemical attack producing symptoms typical of trichothecene exposure indicates that these toxins may have been used as chemical weapons. This conclusion is further supported by the confirmatory evidence provided by the analysis of additional alleged CW samples from Laos and Kampuchea, which are described below.

Analysis of Additional CW Samples From Laos and Kampuchea for the Presence of Trichothecenes

Chemical Systems Laboratory provided three additional suspected chemical warfare samples for analysis for trichothecenes. The first sample (group II/D) consisted of 10 milliliters of water taken from the same chemical attack site in Kampuchea as the leaf and stem sample previously examined (group I/A). The second sample (group II/E) came from the site of a "yellow rain" attack occurring on 13 March 1981 in the village of Muong Cha in the Phou Bia region of Laos. The agent was sprayed from a twin-engine propeller aircraft. The falling substance was described as "like insect spray" and sounded like drizzling rain. It was quite sticky at first, but soon dried to a powder. Symptoms described by victims included nausea, vomiting, and diarrhea. A sample of the agent scraped from the surface of a rock by a victim and carried into Thailand was turned over to US Embassy personnel.

The third sample (group II/F) was taken from the site of a "yellow rain" attack that occurred on 2 April 1981 at Ban Thong Hak in Laos. Twenty-four people reportedly died in this attack and there were 47 survivors. Symptoms included severe skin irritation and rash, nausea, vomiting, and bloody diarrhea. This sample was scraped from the surface of a rock with a bamboo knife by a survivor of the attack. Although the individual took precautions (that is, cloth mask) a severe skin rash and blisters developed.

These three samples were submitted to Dr. Mirocha for analysis. Group II/D (the water sample from Kampuchea) contained 66 ppm of deoxynivalenol and a trace amount of diacetoxyscirpenol (DAS). A trace quantity of group II/E was screened as strong positive

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for trichothecenes. Further analysis of that sample confirmed the presence of high levels of T-2 toxin (150 ppm) and diacetoxyscirpenol (25 ppm). Interference from phtalate compounds (leached from the plastic packaging) made detection of nivalenol and deoxynivalenol difficult. In a second analysis, the extraction process was modified so that nivalenol and deoxynivalenol could be measured accurately. The analysis showed the presence of 143 ppm T-2 and 27 ppm DAS. No nivalenol or deoxynivalenol was detected. Interestingly, examination of the petroleum ether fraction from sample group II/E revealed the presence of a yellow pigment almost identical to that previously identified by Dr. Mirocha in cultures of *Fusarium roseum*, indicating that the yellow powder probably consisted of the crude extract of a *Fusarium* culture.

There was very little of group II/F contained in the vial received for testing. The quantity was too small to be accurately weighed, and inspection of the vial revealed only a very small speck estimated to weigh much less than 0.1 milligram. That speck contained 10 nanograms of diacteoxyscirpenol, a level equivalent to 100 ppm at the very least and probably much higher. The sample size was too small to allow adequate analysis for the other three trichothecenes of interest.

These results, in general, support the hypothesis that trichothecenes have been used as chemical warfare agents in Laos and Kampuchea. The presence of these high levels of trichothecene toxins in water and in yellow powder scraped from rocks argue against natural occurrence, since neither water nor rock is a suitable environment for growth of the fungi required to produce the toxins.

Differences between the analyses of the Kampuchean leaf and stem sample and the water sample collected from the same attack site raise additional questions. The failure to find T-2 toxin in the water sample is probably due to the relative insolubility of T-2 toxin in water. The presence of DAS in the water might be the result of biotransformation or breakdown of T-2, as they are so structurally similar, differing only in the substitution on carbon 8. While this hypothesis cannot be entirely ruled out, it is unlikely on the basis of known biotransformation of T-2 in the laboratory. The initial vegetation sample was not screened for DAS, though the mass spectra from the initial analysis will be reexamined for trace amounts of DAS.

The absence of nivalenol in the water sample is more difficult to explain because nivalenol is water soluble. The effect of environmental conditions and microorganisms on the stability of these compounds may vary widely for each of the specific compounds and may explain the analytical results. Further scientific investigation of these factors is needed.

II. ANALYSIS OF BLOOD SAMPLES FROM CHEMICAL ATTACK VICTIMS

Blood samples drawn from victims of recent chemical attacks have been received for analysis for indications of trichothecene exposure. Little is known concerning the rate of metabolism of trichothecenes in humans; it is difficult, therefore, to estimate the probability of detection of trichothecenes or their metabolites in blood samples. T-2 is rapidly cleared from the blood in animals, and 25 percent of the total dose is excreted within 24 hours after exposure; therefore, it is unlikely that trichothecenes could be detected unless samples were obtained within 24 to 48 hours after an attack. Other blood parameters are affected by the trichothecenes, however, and may prove to be useful markers. The trichothecenes induce a severe leukopenia (decrease in white cell count) which can persist for several weeks following exposure. In addition, the trichothecenes affect some liver and kidney function marker enzymes which can be monitored in the blood.

On 11 October 1981, four whole blood samples and four blood smears were received from the US Embassy, Bangkok. The blood was drawn from four DK soldiers on 7 October inside Kampuchea. Detailed medical histories as well as descriptions of the attack were recorded on each individual from whom a blood sample was taken. All four men were victims of a gas attack occurring in the fall of 1981 near Takong. Symptoms experienced included vomiting, blurred vision, bloody diarrhea, difficulty breathing, dry throat, loss of consciousness, frontal headache, tachycardia, and facial edema. Unfortunately, the samples could not be refrigerated until 48 hours after collection. It was therefore not possible to obtain data concerning white cell counts and blood chemistry. The four whole blood samples were submitted to Dr. Mirocha for analysis for trichothecene metabolites

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because of the possibility (admittedly remote) that some of the metabolites may bind to blood proteins and may still be detectable even three weeks after an attack. These analyses are reported as group V A14–A17 in table D-2.

On 22 October 1981 additional blood samples were received. These had been drawn from nine victims from a 19 September attack and from four control individuals of similar age and background who had not been exposed to a chemical attack. The samples had been properly refrigerated and were accompanied by very complete and detailed medical histories taken by trained medical personnel who examined the individuals. Included in the package were blood smears and heparinized and nonheparinized samples from each individual. The samples were submitted to US Army Medical Research Institute of Infectious Diseases (USAMRIID) for blood assays. These results are reported in table D-3.

The results show no statistically significant differences between exposed and control groups (students T-test). A trend toward depressed white cell counts in eight individuals exposed to chemical agent was observed. Such an observation would be compatible with the clinical picture of toxin exposure; however, it is also compatible with a number of other medical problems and a larger control sample would be required before such results could be adequately interpreted. Abnormal liver and kidney functions were not indicated by the data.

Portions of these blood samples were analyzed by Dr. Mirocha for presence of trichothecenes and/or trichothecene metabolites. The results of those analyses are consistent with trichothecene exposure in at least two of the gassing victims and tend to support the hypothesis that a trichothecene-based agent was used in this attack.

Using the selected ion-monitoring gas chromatography/mass spectroscopy analysis technique, Dr. Mirocha was able to identify tentatively a metabolite of T-2 toxin (that is, HT-2) in the blood of two alleged victims. The compound was identified on the basis of its selected ion masses and gas chromatographic retention times.

The tentative identification of HT-2 in the blood of two victims, and the *trend toward depressed white cell counts* in these same victims, *cannot be taken as conclusive scientific proof of toxin exposure* because the trace amount of the compound present precluded unequivocal identification and quantitation, and also because many other medical problems in addition to toxin exposure can cause a decrease in white cell counts. It is interesting to note that the individual who showed the greatest amount of the compound tentatively identified as HT-2 in his blood, was reported to have received the greatest exposure to the agent and also had the lowest white blood cell count. He was exposed to contaminated water for more than 30 minutes and was the only victim who fell down in the water and actually swallowed some of it. However, the description by victims of symptoms correlating exactly with those associated with trichothecene poisoning provide strong circumstantial evidence that trichothecenes were used as chemical agents in yet another chemical attack in Southeast Asia.

Trichothecenes have been identified previously in environmental samples taken from several other chemical attacks in Laos and Kampuchea. Analysis of control vegetation, water, soil, corn, and rice samples from these areas, as well as reviews of published scientific literature, indicate that the particular toxins that have previously been identified are not known to occur naturally in the combinations found and at the levels detected in Southeast Asia. The latest analysis results contribute another piece of evidence to the growing body of data supporting the charge that trichothecenes have been used as chemical/biological agents in Southeast Asia.

III. OVERVIEW OF NATURAL OCCURRENCE AND SIGNIFICANT PROPERTIES OF TRICHOTHECENES

Historical Trichothecene Mycotoxicoses

The trichothecenes are members of a large group of naturally occurring toxins known as mycotoxins. The word "mycotoxin" is derived from the Greek "mykes" meaning fungus and the Latin "toxicum" meaning poison. It refers to a metabolite produced by a mold that is toxic to man or animals. Mycotoxicoses have been described as the "neglected diseases" and, before 1960, little English-language literature concerning the diseases caused by mycotoxins was available. Interest-

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Table D-3

Peripheral Blood Hemograms of Kampuchean Victims of Chemical Attack

Patient No.	RBC [a]	Hgb [b]	Hct [c]	WBC [d]	Retic [e]	MCV [f]	MCH [g]	MCHC [h]
1	specimen clotted							
2	4.46	12.6	37	4,700	1.0	84	28.5	34
3	4.90	11.8	40	5,700	0.4	81	26	32
4	4.90	10.3	34	1,700	2.1	70	21	30
5	4.92	15.0	46	5,300	1.2	93	32	34
6	4.04	12.6	37	4,300	0.8	93	31	34
7	4.88	15.6	46	3,000	0.5	94	32	34
8	5.56	17.0	50	8,700	1.5	91	31	34
9	4.88	11.2	35	5,000	1.0	73	23	32
Controls:								
10	6.23	12.5	41	7,200	0.8	66	20	30
11	4.47	11.9	38	8,000	0.9	85	26.5	31
12	4.88	12.9	41	5,100	2.0	85	26.5	32
13	5.16	15.6	46	6,500	1.0	90	30.5	34
Normal range:								
Male	4.5-6.0	14-18	40-54	7,400		80-94	27-32	33-38
Female	3.5-5.0	12-16	37-47	±2,000				

	BUN [i]	Creatinine	SGPT [j]	Alkaline Phosphatase
1	9.0	3.5	48	132
2	8.5	0.8	36	47
3	8.0	1.4	12	75
4A	11	1.3	6	94
4B	10.5	1.2	6	68
5	6.0	1.6	12	84
6	7	1.2	18	115
7	8.5	1.7	6	69
8	10	1.5	36	79
9	12.5	1.4	12	70
10	10.5	1.8	12	86
11	12	0.8	24	74
12	12	1.4	6	76
13	9.0	1.2	30	102
Normal Range				
Male	7-20	0.4-1.7	6-37	24-69
Female				23-71

[a] Red blood cells x10^{-6} (#/cc)
[b] Hemoglobin (gm/100cc)
[c] Hematocrit (%)
[d] White blood cells (#/cc)
[e] Reticulocytes (#/cc)
[f] Mean corpuscular volume (μ^3)
[g] Mean corpuscular hemoglobin ($\mu\mu g$)
[h] Mean corpuscular hemoglobin concentration (%)
[i] Blood urea nitrogen (mg%)
[j] Serum glutamic pyrovic transaminase

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ingly, the first comprehensive studies of mycotoxin diseases were conducted in the Soviet Union in the late 1930s. Thus, Soviet scientists have been involved in research with some of these compounds for almost 30 years longer than their Western counterparts (see section V of this annex). The Soviet Union has had serious problems with mycotoxin contamination of food and has suffered several severe outbreaks of disease in humans.

The group of mycotoxins that has figured most prominently in Soviet scientific literature since the 1940s are the trichothecenes. They are a group of chemically related, biologically active fungal metabolites produced primarily by various species of *Fusarium*. Table D-4 lists some of the toxins in this group and producing fungi. The fungi are well-known plant pathogens that frequently invade numerous agricultural products.

Trichothecene toxins, perhaps more than any other mycotoxins, have been associated with acute disease in humans. Most of the human intoxications occurred in the Soviet Union (table D-5). The earliest recognized outbreak occurred in 1891 in the Ussuri district of eastern Siberia. Humans who consumed contaminated grain exhibited headache, chills, nausea, vomiting, vertigo, and visual disturbances. Dogs, horses, pigs, and domestic fowls were reported to be affected.

The most extensive mycotoxicosis outbreak, reported to have caused multiple fatalities in man, also occurred in the Soviet Union. In 1944, 30 percent of the population of Orenburg was affected by alimentary toxic aleukia or ATA, a disease later shown to be due to ingestion of trichothecene toxins. Over 10 percent of the entire population of the Orenburg district died of the disease. Numerous other outbreaks of ATA occurred in the Soviet Union, primarily between the years 1942 and 1947. The contamination was traced to overwintered millet, wheat, and barley infected with *Fusarium*. Symptoms of the disease included vomiting, skin inflammation, multiple hemorrhaging (especially of the lung and gastrointestinal tissue), diarrhea, leukopenia, and suppression of bone marrow activity.

In 1939, Nikita Khrushchev was dispatched to the Ukraine region of Russia by Premier Joseph Stalin to organize and improve agricultural operations and to identify the disease that was causing the deaths of many horses and cattle. The problem was traced to hay and straw contaminated with *Stachybotrys atra*. The disease, later referred to as stachybotryotoxicosis, occurred after ingestion or contact with the contaminated grain. Symptoms included ulcerative dermatitis, perioral dermatitis, blood dyscrasias, hemorrhagic syndromes, abortion, and death. The greatest economic impact was due to loss of horses, but cattle, sheep, poultry, and humans were also affected.

Other disease outbreaks in which similar symptoms were exhibited occurred in 1958 and 1959 among

Table D-4

Trichothecene-Producing Fungi

Type	(A) T-2 Type	(B) Nivalenol-Type	(C) Macrocylic
Trichothecenes	T-2 toxin HT-2 toxin Diacetoxyscirpenol Neosolaniol	Nivalenol Monoavetylnivalenol Diacetylnivalenol Deoxynivalenol	Roridins Verrucarins Satratoxins Vertisporin
Fungus	*F. tricinctum* *F. roseum* *F. equiseti* *F. sporotrichioides* *F. lateritium* *F. poae* *F. solani* *F. rigidiusculum* *F. semitectum*	*F. nivale* *F. opisphaeria* *F. roseum*	*Myrothecium verrucaria* *M. roridum* *Stachybotrys atra* *Verticimonosporium diffractum*

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Table D-5

Historical Trichothecene Mycotoxicosis

Toxicosis	Districts and Affected Species	Symptoms
"Taumelgetreide" toxicosis	USSR Man, farm animals	Headache, nausea, vomiting, vertigo, chills, visual disturbances
Alimentary toxic aleukia	USSR Man, horse, pig	Vomiting, diarrhea, multiple hemorrhage, skin inflammation, leukopenia, angina
Stachybotryotoxicosis	USSR, Europe Horse	Shock, somatitis, hemorrhage, dermal necrosis, nervous disorders
Bean-hull toxicosis	Japan Horse	Convulsion, cyclic movement
Dendrodochiotoxicosis	USSR, Europe Horse	Skin inflammation, hemorrhage
Moldy corn toxicosis	United States Pig, cow	Emesis, hemorrhage
Red mold toxicosis	Japan, USSR Man, horse, pig, cow	Vomiting, diarrhea, congestion, and hemorrhage of lung and intestine

horses and cattle in the Soviet Union and Eastern Europe. Thousands of animals were lost in these outbreaks. Other intoxications were reported subsequently in Japan, Europe, the Soviet Union, and the United States, affecting various domestic animals and—in the case of red mold toxicosis—affecting man. All of these diseases have now been shown to be due to ingestion of trichothecenes rather than to an infectious agent. In earlier disease outbreaks, the levels of toxin present in the contaminated grain was not measured; however, the levels of nivalenol and/or deoxynivalenol measured in toxic grains implicated in more recent outbreaks (that is, "moldy corn toxicosis" and "red mold toxicosis") were typically between 2 and 8 ppm.

Natural Occurrence of Trichothecene Mycotoxins

Publications concerning the occurrence of trichothecenes have been relatively scarce because of the lack of convenient detection methods and the complexity of the trichothecene family of compounds. Only recently have scientists developed methods capable of distinguishing between close structural derivatives and accurately quantitating the levels of toxin present (see table D-6 for comparison of analytical methods). Extreme care must be taken when reviewing the scientific literature on natural occurrence of these compounds, because erroneous conclusions can be drawn on the basis of results obtained with inadequate analytical techniques. Misidentification of compounds and gross overestimation of concentrations have occurred using techniques such as thin layer chromatography as the basis of analysis.

Table D-7 lists the reports of natural occurrence of T-2 toxin, diacetoxyscirpenol, and nivalenol that were obtained from a literature search of over 3,000 citations concerned with trichothecene toxins. Levels that are questionable on the basis of techniques used are indicated. It is immediately apparent that the levels of toxins found in the various samples from Laos and

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Table D-6

Physicochemical Methods for Detection of Trichothecenes in Feedstuffs

Method	Trichothecenes Detected	Detection Limits	Required Standards	Use and Limitation
Thin-layer chromatography 1-dimension	All — —	0.1 microgram/spot (H_2SO_4)	Reference Standard	Qualitative Interference Not confirmatory
Thin-layer chromatography 2-dimension	All	0.1-1.0 microgram/spot (H_2SO_4)	Reference Standard	Qualitative Less interference Confirmatory
Gas-liquid chromatography	Nonhydroxylated or TMS derivatives	0.03-0.05 microgram/microliter injection	Reference Standard	Quantitative Monoglyceride interference Equivocable interference
Gas chromatography/mass spectrometry-normal scanning mode	TMS derivatives	0.02-0.05 microgram/microliter injection	Reference Standard or Spectrogram	Semiquantitative Less interference Unequivocable identification
Gas chromatography/mass spectrometry-selection ion monitoring	TMS derivatives	0.007-0.02 microgram/microliter injection	Reference Standard or Spectrogram	Quantitative Best for complex mixtures Unequivocable identification
Nuclear-magnetic-resonance	All	—	Reference Standard or Spectrogram	Confirmatory Purified toxin structure elucidation
Radioimmunoassay (developmental stage)	T-2 toxin	1-20 nanograms	Rabbit anti–T-2 toxin antibody	Sensitive Low interference
			HT-2 toxin	Relative structural specificity

Kampuchea are highly unusual, even if one accepts the questionable reports in table D-7 as valid. The levels of these toxins (150 ppm of T-2 toxin, 109 ppm of nivalenol, more than 100 ppm of diacetoxyscirpenol, and 66 ppm of deoxynivalenol) are markedly higher than those reported to occur in nature.

It should also be noted that the incidences recorded in table D-7 concern levels of toxin produced when *Fusarium* is growing on its ideal substrate, while the Laos and Kampuchea samples were taken from surfaces that would be extremely unlikely to support *Fusaria* growth and toxin production—that is, the surface of rocks and water. Higher levels of toxin production can, of course, be induced when the mold species is grown in pure culture under ideal conditions in the laboratory; for instance, the Soviets have succeeded in producing 4 grams of T-2 per kilogram of substrate. In a natural environment, however, the *Fusaria* species cannot compete well with other molds such as species of *Aspergillus* and *Penicillium*, and, as in table D-7, levels of toxin produced are orders of magnitude lower.

The conclusion that the levels of toxins found in the Southeast Asia samples could have occurred only by means of an unnatural mechanism is also strengthened by surveys of the area conducted by various research-

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Table D-7

Spontaneous Occurrence of Trichothecene Mycotoxins

Toxin	Country	Source	Concentration (parts per million)	Reference [a]
T-2:				
	USA	Mixed feed	0.08 [b]	15
	UK	Brewer's grains	ND [c]	19
	India	Sweet corn	4 [b,d]	5
	Canada	Corn	ND	4
	India	Sorghum	ND [d]	22
	Canada	Barley	25 [d]	20
	India	Safflower seed	3-5 [d]	6
	US	Corn stalks	0.11 [b]	16
	US	Feed supplement	ND	7
	US	Corn	2	8
	US	Mixed feed	0.3	14
	France	Corn	0.02 [b]	10
	US	Corn	ND	2
Diacetoxyscirpenol:				
	US	Mixed feed	0.5	15
	US	Mixed feed	0.38	15
	India	Safflower seed	3-5 [d]	6
	India	Sweet corn	14 [d]	5
	Germany	Corn	31.5 [d]	23
	US	Corn	0.88	21
Deoxynivalenol:				
	US	Corn stalks	1.5 [b]	16
	US	Corn	1.8 [b]	15
	US	Corn	1.0 [b]	15
	US	Corn	0.1 [b]	15
	US	Mixed feed	0.04 [b]	15
	US	Mixed feed	1.0 [b]	15
	US	Mixed feed	1.0 [b]	15
	US	Corn	7.4	9
	US	Corn	0.125 [d]	21
	US	Corn	trace-25 [d]	2, 21
	US	Corn	1.1-10.7	26
	US	Corn	41	25
	US	Corn	1.0 [b]	17
	US	Oats	5	17
	Japan	Barley	ND	18
	US	Corn	1.0 [b]	13
	US	Corn	0.06 [b]	13
	US	Mixed feed	0.07 [b]	13
	France	Corn	0.6 [b]	10
	South Africa	Corn	2.5	11
	Zambia	Corn	7.4	11
	US	Corn	ND	2
	Japan	Barley	7.3	18
	Austria	Corn	1.3	24
	Austria	Corn	7.9	24
	Canada	Corn	7.9	24

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Table D-7 (Continued)

Spontaneous Occurrence of Trichothecene Mycotoxins

Toxin	Country	Source	Concentration (parts per million)	Reference [a]
Nivalenol:				
	Japan	Barley	ND	18
	France	Corn	4.3 [b]	10
Partially characterized trichothecenes:				
	US	Corn	ND	25
	India	Safflower seed	ND [d]	6
Skin irritant factors—not analyzed chemically:				
	US	Corn	93 positive [b] of 173	3
	US	Corn	Multiple positive samples	21
	Yugoslavia	Corn	16 positive of 191	1

[a] References:

1. Balzer *et al.* (1977)
2. Ciegler (1978)
3. Eppley *et al.* (1974)
4. Funnel (1979)
5. Ghosal *et al.* (1978)
6. Ghosal *et al.* (1977)
7. Hibbs *et al.* (1974)
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9. Isshi *et al.* (1975)
10. Jemmail *et al.* (1978)
11. Marasas *et al.* (1977)
12. Miller (1976)
13. Mirocha (1979a)
14. Mirocha (1979a)
15. Mirocha *et al.* (1976b)
16. Mirocha *et al.* (1979a)
17. Mirocha *et al.* (1979b)
18. Morooka *et al.* (1972)
19. Petrie *et al.* (1977)
20. Puls and Greenway (1976)
21. Romer, T., Ralston Purina, St. Louis, MO (personal communications
22. Rukmini and Bhat (1978)
23. Siegfried (1979)
24. Vesonder and Ciegler (1979)
25. Vesonder *et al.* (1976)
26. Vesonder *et al.* (1978)

[b] Zearalenone (F-2 toxin) also detected in the sample.
[c] ND = toxin concentration was not determined.
[d] Levels that are questionable on the basis of techniques used.

ers. Surveys of the toxigenic fungi and mycotoxins of Southeast Asia conducted by the Mahidol University in Bangkok and the Massachusetts Institute of Technology, have not revealed the presence of T-2, nivalenol, deoxynivalenol, or diacetoxyscirpenol, although other mycotoxins such as aflatoxin, were identified. These results were confirmed by our analysis using our own methodology of normal flora samples of vegetation, soil, water, corn, and rice from Kampuchea that revealed the presence of no trichothecenes.

Skeptics have formulated theoretical explanations for the analytical results to support a hypothesis of natural occurrence of these toxins. It was postulated that the trichothecenes found were absorbed through the roots of a plant, translocated to the leaves, and exuded and washed onto the surface of a rock and into water where they were found. A 1981 publication by Jarvis *et al.* reported a Brazilian shrub that appeared to absorb, translocate, and chemically alter a macrocyclic trichothecene produced by a soil fungi. While this citation is used to support a hypothetical mode for natural deposition in Southeast Asia it should be noted that the plant reported by Jarvis *et al.* did not exude the toxin, that the toxin was extremely phytotoxic to all other plants assessed, and that the plant was not capable of *de novo* trichothecene synthesis. No other trichothecenes have been found to be absorbed and translocated in any other plant in this manner. Control samples of soil and vegetation from Southeast Asia do not support endemic presence of these toxins. The appearance of these particular trichothecene toxins in these high levels in environments generally inhospitable to their formation cannot reasonably be attributed to a natural contamination.

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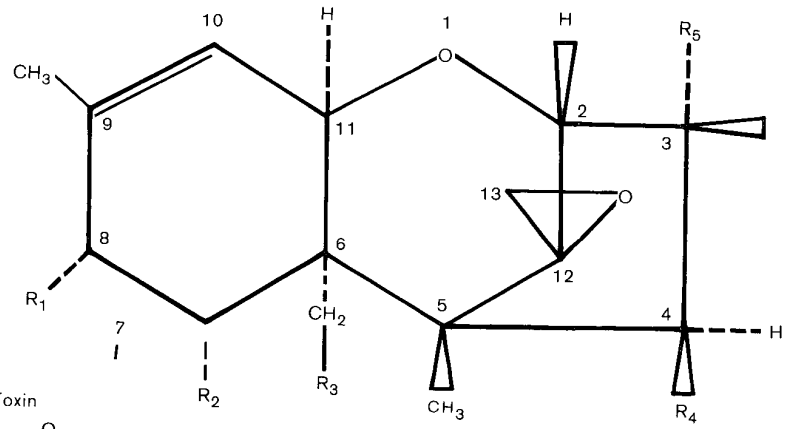
Chemical and Physical Properties of the Trichothecenes

When considering the suitability of trichothecenes as agents, factors such as stability, solubility, and ease of production must be considered. The general structure for the trichothecene group is shown in figure D-1. There are over 40 currently known, naturally occurring, 12, 13 epoxytrichothecenes. The R groups may be hydroxyls, acylated hydroxyl groups, or esters. The R group for the toxins detected in Sample Group I/A are shown below the general structure. All of the compounds have in common an olefinic double bond at carbon atoms 9 and 10 and an epoxy group at carbon atoms 12 and 13. These compounds are stable, especially in the solid form. They may be stored for years at room temperature with no loss of activity. They are heat stable with no loss of activity noted after heating for 1 hour at 100 degrees centigrade. The solubility depends on the R groups; highly hydroxylated derivatives are more water soluble. The compounds are also quite stable in solution. Detoxification can be accomplished by treatment with strong mineral acid, which will open the 12 to 13 epoxide bond and abolish all biological activity. Most of the toxins are well absorbed through mucous membranes and some through skin; this property is also a function of the R group.

Some of these compounds have been synthesized chemically; however, biosynthesis employing Fusarium species is the most effective way to produce large quantities. In a preliminary search of recent Soviet open source literature, 50 articles dealing with the trichothecenes were reviewed. Of these, 22 dealt with defining optimum conditions for biosynthesis of the compounds. N. A. Kostyunina has reported production of T-2 toxin at levels of 4 grams per kilogram of

Figure D-1

General Structure of Trichothecenes



T-2 Toxin

$R_1 = O-\overset{O}{\overset{\|}{C}}-CH_2-CH(CH_3)_2$

R_2=H
R_3=OAc
R_4=OAc
R_5=OH

Nivalenol

R_1=O
R_2=OH
R_3=OH
R_4=OH
R_5=H

Deoxynivalenol

R_1=O
R_2=OH
R_3=OH
R_4=H
R_5=H

Diacetoxyscirpenol (DAS)

R_1=H
R_2=H
R_3=OAc
R_4=OAc
R_5=OH

Unclassified

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substrate (normally wheat grain, or rice). Numerous industrial microbiology plants have been identified in the Soviet Union. Some of these are involved in production of single-cell protein for fodder additives, others produce antibiotics, and the function of still others is unknown. As published in the open literature, Fusaria are produced in the Soviet Union at the Berdsk Chemical Works, which is under the Main Administration of the Microbiological Industry and is located near the "Science City" of Novosibirsk in Siberia. Such a facility also has been a suspect biological warfare (BW) agent production and storage facility. The only difference between an antibiotic and mycotoxin is their target specificity. Both are produced by fungi, but the mycotoxins are relatively more toxic to man than to microorganisms. Mycotoxins can be produced in good yield employing the same techniques that are used to produce some antibiotics. Thus, it may be concluded that the Soviets could produce trichothecenes in large amounts. They produce an antibiotic that is a trichothecene derivative, which would provide an ideal cover for agent production facilities.

Medical Effects of the Trichothecenes in Humans

The most prominent symptoms associated with trichothecene poisoning are listed in table D-5. Striking among these is the rapid onset of vomiting with severe itching and tingling of the skin. Hemorrhage of the mucous membranes and bloody diarrhea follow. That table also presents symptoms reported to have been caused by the trichothecenes in gas attack victims in Laos, Kampuchea, and Afghanistan. The correlation is striking.

LD_{50} values (dose required to produce death in 50 percent of a test population) of the trichothecenes in laboratory animals range from 0.1 mg/kg to greater than 1,000 mg/kg depending on the particular toxin, species, and route of exposure. The LD_{50} of T-2 toxin in cat is 0.5 mg/kg. However, the ED_{50} (dose required to produce a desired physiological effect in 50 percent of a test population) is much lower. The ED_{50} to produce a vomiting reaction is 0.1 mg/kg, and for skin irritation it is in the tenths of microgram range.

Most of the data concerning the toxicological effects of the trichothecenes are derived from animal data in which pure compounds were administered by oral, subcutaneous, intraperitoneal or intravenous routes. Unfortunately, there are no reports concerning the effects of inhalation of mixtures of the compounds. Therefore, it is difficult to speculate concerning the effects that would be expected in humans who were exposed to an aerosol of mixtures of these very potent toxins. The most useful data concerning exposure in humans was obtained in a Phase I clinical evaluation of anguidine (diacetoxyscirpenol) as an anticancer drug. Diacetoxyscirpenol was administered by intravenous infusion. Doses of 3 $mg/m^2/day$ caused immediate onset of nausea, vomiting, diarrhea, somnolence (and/or mental confusion), fever, chills, a generalized erythema with a burning sensation, hypotension, dyspnea, stomatitis, hives, and ataxia. Because of the side effects the treatment was discontinued. The properties which make the use of diacetoxyscirpenol potentially useful as an anticancer drug are the same as those responsible (in part) for its extreme toxicity. It and the other trichothecenes cause extensive damage to rapidly dividing cells such as tumor cells. Unfortunately, the cells of the lining of the gastrointestinal tract and bone marrow are also rapidly dividing and the effects of the trichothecenes on these cells result in severe rapid degeneration of these tissues. The compounds also have direct effects on the clotting factors in the blood (that is, a primary effect on Factor VII activity and a secondary effect on prothrombin) which result in excessive hemorrhage following trauma.

The other useful body of clinical data concerning the effects of trichothecenes in humans is drawn from descriptions of the course of the disease in the natural outbreaks that occurred in the Soviet Union. The clinical picture may be divided into four stages. The effects produced are very similar to radiation poisoning and there is a latent phase in which the overt symptoms disappear, as occurs in radiation poisoning.

The first stage occurs within minutes to hours after ingestion of toxic grains. The symptomatology described was produced by oral exposure to low doses. In exposure by inhalation, the symptoms may be more pronounced or the time course accelerated. The characteristics of the first stage include primary changes, with local symptoms, in the buccal cavity and gastrointestinal tract. Shortly after ingestion of toxic grain, the patient experiences a burning sensation in the

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mouth, tongue, throat, palate, esophagus, and stomach as a result of the toxin's effect on the mucous membranes. The tongue may feel swollen and stiff and the mucosa of the oral cavity may be hyperemic. Inflammation of the gastric and intestinal mucosa occurs, along with vomiting, diarrhea, and abdominal pain. In most cases excessive salivation, headache, dizziness, weakness, fatigue, and tachycardia accompany the initial stage. There may be fever and sweating, but the body temperature normally does not rise. The leukocyte count may begin to decrease in this stage and there may be an increased erythrocyte sedimentation rate. This first stage may last from three to nine days.

The second stage is often called the latent stage or incubation period because the patient does not feel ill and is capable of normal activity. It is also called the leukopenic stage because its main features are disturbances in the bone marrow and the hematopoietic system, characterized by a progressive leukopenia, a granulopenia, and a relative lymphocytosis. In addition, anemia and decreases in erythrocytes, in the platelet count, and hemoglobin occur. Disturbances in the CNS and autonomic nervous systems may occur. Weakness, vertigo, fatigue, headache, palpitations, and mild asthmatic conditions may occur. Visable hemorrhagic spots (petechiae) begin to appear on the skin and this marks the transition to the third phase. The second stage may last three to four weeks. The transition to the third stage is sudden and symptoms progress rapidly.

In the third stage petechial hemorrhages occur on the skin of the trunk, arms, thighs, and face and head. They can vary from a millimeter to a few centimeters in size. Capillaries are very fragile and any slight trauma results in hemorrhage. Hemorrhages of the mucous membranes of the mouth, tongue, soft palate, and tonsils occur. Nasal, gastric, and intestinal hemorrhages can be very severe. Areas of necrosis begin to appear on the lips, fingers, nose, jaws, eyes, and in the mouth. Lymph nodes are frequently enlarged and the adjoining connective tissue can become so edematous that the patient has difficulty opening his mouth. Blood abnormalities previously described are intensified. Death may occur from hemorrhage, strangulation (due to swelling) or secondary infection.

The fourth stage is convalescence. Three to four weeks of treatment are required for disappearance of necrotic lesions and hemorrhagic effects. Two months or more may elapse before the blood-forming capability of the bone marrow returns to normal.

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ANNEX E [1]

MEDICAL EVIDENCE

Southeast Asia

Since 1976, multiple sources—refugees, relief medical and civilian workers, and many specially qualified physicians—consistently have detailed unusual signs and symptoms of victims of "yellow rain." Specifically, victims in Southeast Asia subjected to a direct attack of the yellow powder, mist, smoke, or dust would be seen to begin retching and vomiting in a matter of minutes. This and the effects described below were not pronounced in individuals even 100 meters from the attack zone, indicating a relatively dense chemical/carrier combination that was effective in low wind conditions.

Unlike that caused by a traditional riot-control nausea agent, the initial induced vomiting following exposure to "yellow rain" was protracted over hours to days and was often accompanied by dizziness, with rapid heartbeat and apparently low blood pressure, chest pain, loss of far-field vision, and a feeling of intense heat and burning on the skin, but not described as being most acute in the groin and axillae. Thus, the acute signs and symptoms match some of the effects of traditional vomiting and urticant agents, but clearly not all.

A significant number of victims also reported intense "red eyes," "bleeding gums," convulsions or more often trembling, and vomiting of blood with or without production of copious amounts of saliva within the first hours after the attack. Again, this could last many hours to days, apparently depending on the exposure level. Thick mucus, pinpoint pupils, respiratory collapse, prolonged spasticity, and involuntary urination or defecation were seldom reported after a "classic" attack of "yellow rain," and this absence helped to rule out organophosphate nerve agents in the minds of CW experts. Many medical and environmental samples also ruled out these and other traditional agents such as DM, DS, and others.

Many observers of the "yellow rain" effects reported formation within several hours of small (1 centimeter), homogeneous, hard, fluid-filled blisters over only exposed areas of skin, frequently including the victim's hands, arms, entire throat, and face—whenever skin was uncovered. In most cases, the vomit, after two to eight hours, contained blood, and in many cases a good deal of it. About half of those receiving the most concentrated doses of yellow material, who had been directly under the spray, were observed several hours after the attack to cease vomiting temporarily. This interval was often followed in five to 15 minutes by a period of great pain when the victim would hold his abdomen and emit a "gush" of blood from his mouth and nose. These individuals were usually dead within minutes after that. Close questioning by physicians of those who witnessed these final moments leave no doubt that these observed effects were the results of severe gastrointestinal bleeding, significant pulmonary bleeding, temporary compression of accumulated blood in the stomach, and finally projectile vomiting of as much as several hundred milliliters of blood. These findings were consistent with animal and human autopsies.

Very recent, as yet unpublished data on effects of these compounds in animals show striking and sudden impairment of several elements of the normal blood clotting mechanisms. Observers and victims have reported signs and symptoms occurring within a few minutes to a few hours after exposure. These signs and symptoms, including bleeding, the other systemic effects mentioned above, and in some cases death even from skin absorption, are consistent with these emerging laboratory data.

Many victims of the yellow material received less than the full brunt of a spray, or entered the attack zone several hours to two days later, or consumed food or water contaminated by the material. These individuals often within the next 24 hours developed signs and symptoms similar to those of the more directly

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affected (but often without pronounced skin effects if they did not contact the powder residue directly). In addition to attacks of intense vomiting (five or six times a day), they also had diarrhea, with bloody stools passed up to eight times a day. Bleeding under the fingernails and around the skin of the eyes and severe bruising of the skin are also commonly reported. Opiates helped the fluid loss in adults; but, in children or young persons not able to tolerate the treatments of raw opium and water, death occurred in about half the cases after 10 days to two weeks. On the basis of reported signs and symptoms, the cause of delayed death was almost certainly dehydration.

In many cases chemical attacks are reported to produce symptoms other than the ones described here. There has always been, however, a direct association of the symptoms above with reports of "yellow rain" attacks—that is, when yellow material is used these symptoms appear; other agents may give rise to other symptoms. Although it is possible to have one or even several of these symptoms associated with traditional CW agents, no expert has been able to "fit" the sequence, severity, and consistency with any of them. In many cases victims and observers were examined, histories taken, and interviews conducted by several health professionals weeks apart. Remarkable consistency has been observed.

From the beginning of the "yellow rain" episodes in 1976, autopsies have occasionally been reported anecdotally. Some have been done by less than expert technique, some by nonphysicians, and some were on animals rather than human victims. However, the consistency of the early reported "putrefaction" or "rottenness" of the digestive tract within 12 to 48 hours after death led many forensic experts to suspect that one effect of the poison, whatever it was, was to cause necrosis (cell death) of rapidly dividing mucosa (mucous membranes), especially in the stomach and upper small intestine. Other autopsy findings included hyperemia (engorgement with blood) of digestive mucosal linings, and remarkably intense congestion and swelling in the lungs, liver, spleen, and sometimes the kidneys. These and other findings often led experts in toxicology and pathology to suggest mycotoxin or even trichothecene intoxication based on clinical and pathological data alone.

Although not a common cause of death, trichothecene effects have been reported in the forensic, oncological, and toxicological literature for several years. Unpublished findings often were discussed in symposiums. In several dozens of cases, toxic effects in humans and animals have been carefully recorded, and they match those of the "yellow rain" story with good precision. (See table E-1.) There are no additional signs effects of known trichothecene intoxication not frequently reported by victims, nor are there any reported "yellow rain" symptoms that cannot be explained by the effect of the four specific trichothecene toxins found in the samples, and the doses inferred from the operational situation and description.

From a medical viewpoint, there are no significant differences in the reporting from Laos and Kampuchea. The timing and delivery systems have sometimes varied, but the effects of the chemical agent, both clinically and pathologically, are identical. In one case, a series of blood samples from Kampuchean victims also showed a trend toward leukopenia (reduction in number of white blood cells) and the presence of a trichothecene metabolite (HT-2) consistent with trichothecene intoxication (see annex D for blood analysis results). To a first order, dose-response effects are also seen, and routes of administration are consistent with effects.

Public Health Issues. An early hypothesis (1978-79) was that a significant number of the deaths, especially in Laos, could be explained by the heavy use of riot-control agents such as CS, CN, DM, and agents which cause itching and/or blistering. The hypothesis was rejected quickly on two grounds. First, trace contaminant analysis did not show the presence of any of these compounds in samples (several samples did, however, contain a trichothecene precursor). Secondly, contrary to commonly held views, the epidemiology of diseases endemic to the Central Highlands and the public health of the H'Mong do not support the view of malnourished, disease-ridden, and weak persons who would succumb easily to riot-control agents. Also, a number of studies have shown the opposite: a relatively low incidence of pulmonary disease (lower than what could otherwise account for certain effects); better nutritional states than could otherwise account for death in 10 days to two weeks from water loss (dehydration) and calorie depletion; and a death rate of near zero from causes other than infection, gerontological causes, and trauma.

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Table E-1

Comparison of Reported "Yellow Rain" Effects With Known Trichothecene Effects

"Yellow Rain" Reports [a]	Effects of Trichothecenes
1. Nausea, vomiting—severe, immediate	1. Nausea, vomiting—severe, immediate
2. "Falling down, world turning"	2. Dizziness
3. "Burning of skin" . . . small blisters	3. Generalized erythema with a burning sensation of skin
4. "Shaking all over, flopping like fish out of water"	4. Ataxia (failure of muscular coordination), occasional tremors and convulsions
5. "Bleeding eyes"	5. Congestion of the sclera (white outer coat of eyeball) and blood in tears
6. "Pounding" chest, rapid heartbeat, weakness	6. Hypotension (abnormally low blood pressure) with secondary rise in heart rate
7. Severe pain in center of chest	7. Angina (substernal chest pain)
8. Sleepiness, "not able to talk"	8. Somnolence, central nervous system symptoms
9. Bleeding gums and profuse saliva	9. Stomatitis (inflammation of oral mucous membranes) and ptyalism (excessive salivation)
10. "Can't breathe"	10. Shortness of breath
11. "Skin and body hot with cold"	11. Fever and chills
12. Diarrhea with blood	12. Diarrhea with blood
13. Loss of appetite, inability to eat	13. Anorexia
14. Bleeding into skin and fingernails	14. Thrombocytopenia (decrease in number of platelets—white blood cells involved in clotting of blood) and purpura (skin discoloration caused by hemorrhage into tissues)
15. Drop in white blood cell count	15. Leukopenia and anemia
16. "Rotten esophagus, stomach, intestines; soft spleen and liver"	16. Rapid necrosis of linings of gastrointestinal tract; lymphoid necrosis in spleen and liver
17. Swelling of all organs	17. Congestion of all organs

[a] Effects are immediate at levels near to or above a rough estimate of 500 to 1,000 mg total body burden for an adult. Although inhalation data are pending, the levels are consistent with reported lethal and sublethal doses. Trichothecenes in combination, when directly ingested or inhaled, or in purified form, are more toxic in lower concentrations and the order of signs and symptoms and timing varies.

Afghanistan

Some deaths with bleeding have been described in the accounts from Afghanistan. In one series of cases a physician examined a number of persons who had been exposed to sublethal doses of a yellow smoke/black smoke combination attack and one man near death after a series of attacks. Hemoptysis (nasal bleeding)—but not hematemesis (bleeding from the gastrointestinal tract)—was reported in about half of these and other cases.

Several features of at least one of the chemical agents—an incapacitant—used in Afghanistan defy explanation at this time. No good candidate has yet been identified which will selectively inhibit the central nervous system to cause unconciousness for several hours as reported. A second finding has been the presence of a dermal anaesthesia, affecting only exposed areas of skin.

Postattack Medical Survey. There is evidence that after some of the attacks in Laos and Afghanistan, Soviet or Communist (Pathet Lao) forces entered the attack zones to conduct surveys. Several reports indicate that a group of survivors from a toxin attack on a Laotian village were taken several kilometers from the village and injected with a small volume of a clear solution said by their captors to be a "new" medicine to "assess the gas." The injections were given intramuscularly in the upper arm and reportedly did nothing to alleviate the weakness, nausea, vomiting, or diarrhea suffered by the survivors. One source reported the effect of the drug was to cause an immediate sensation of warmth throughout his body. Only the use of opium later eased the discomfort, after the survivors had lied to their captors about how much better the new medicine made them feel. It is probable that the procedure was a test, either of a new antidote or of a drug developed to reduce incapacitation from the nausea and vomiting.

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(b)(3)

Similarly, in a few cases in Afghanistan, Soviet troops were reported to disembark from helicopters or armored personnel carriers at the edge of an attack site. Three or four, dressed in full anticontamination gear, walked among the dead; examined the corpses; and, opening them with a crude autopsy incision, examined the organs in the abdominal and thoracic cavities. In one report a solution was poured into the incision. When the corpses were later recovered by Mujahedin guerrillas, the body cavity contents were destroyed beyond recognition. These bizarre stories would be discounted were it not for the past reliability and quality of reporting from the sources, which is believed excellent.

These and a small number of additional reports support the hypothesis that the perpetrators of some of the attacks are interested in studying aftereffects, lethality, or some other quasi-experimental aspect of use of a new chemical weapon. Details are not sufficiently clear to explain the purpose of the above events, and "destruction of evidence" is by itself not an entirely credible explanation. Recent indications from Afghanistan indicate that one purpose of these reviews of bodies and the field surveys is to determine levels of toxic materials still present in the attack zone before Soviet troops occupy it.

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ANNEX F

REPORT OF THE WEAPON AND SPACE SYSTEMS INTELLIGENCE COMMITTEE, APRIL 1980, ON USE OF CHEMICAL WARFARE IN AFGHANISTAN, LAOS, AND KAMPUCHEA

The Weapon and Space Systems Intelligence Committee has reviewed all available intelligence as of 25 March 1980 to determine if chemical agents have been used in Afghanistan, Laos, and Kampuchea.

Afghanistan

1. There is an even chance that lethal chemicals such as nerve agents have been used by the Soviets in Afghanistan but we lack confirmatory evidence.

2. We are almost certain that irritant agents have been used by the Soviets against the Afghan insurgents.

3. The presence of Soviet chemical defense forces in Afghanistan provides the capability to engage in chemical warfare. We cannot predict whether the Soviets will exercise this capability.

The earliest reported use of chemical weapons occurred during the summer of 1979, when refugees claimed that "toxic gas bombs" were used in Bamian Province. In the fall of 1979 reported on the presence of "chemical" bombs at several airfields and their use against insurgents. The bulk of reporting since then has come from Afghan refugees, who have described aircraft attacks with gas bombs and canisters, causing dizziness, sickness, breathing difficulty, and in some cases death.

confirmed the deployment of a chemical defense battalion (which is standard issue to Soviet forces) at Qonduz and Shindand, and chemical defense equipment has been observed in the Kabul area. The unit at Qonduz has set up two small nonstandard personnel and clothing decontamination stations. (b)(1) (b)(3)

The evidence for the Soviet possession of irritant agents is convincing. There is no conclusive evidence of Soviet use of lethal agents. We believe that any chemicals used or stored in Afghanistan would be supplied by the Soviets. We would require samples of munitions or fragments, contaminated materiel, (b)(3) and/or the debriefings of victims by qualified medical experts to establish not only that lethal agents were used but also the exact type of agent employed. (b)(1)(3) (b)(3)

Laos

1. We are almost certain that the Vietnamese (PAVN) and Laotian People's Democratic Army forces have used lethal chemical agents against the dissident H'Mong (Meo) tribesmen over a period of more than three years. The most recent report is from October 1979. (b)(3) (b)(3)

2. From the reported symptoms, at least three types of chemical agents have been used: a nerve agent; an unidentified lethal chemical or combination of chemicals; and an irritant agent of unknown type. (b)(3)

3. There is good evidence that the Soviets have supplied chemical munitions and advice to PAVN forces and the Laotians. (b)(1) (b)(3) (b)(3) (b)(3)

4. Stores of chemical munitions probably are located near Xiangkhoang and Vieng Sai (Military Region II), Savannakhet (Military Region III), and Pakxe (Military Region IV). (b)(1) (b)(3) (b)(3)

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(b)(3)

Refugee and clandestine reporting has described repeated chemical attacks on combatants and the civilian population with rockets, bombs, sprays, and artillery weapons. Eyewitnesses have been interviewed by US medical experts. However, chemical analysis of roofing material supposedly contaminated with a lethal chemical agent proved negative. provide good evidence that the Soviets have supplied unidentified chemical agents and munitions to Laos and have provided assistance in usage and storage.

Kampuchea

1. There is insufficient evidence to support allegations that PAVN forces or those of the People's Republic of Kampuchea (PRK) have used lethal chemicals against Democratic Kampuchean (DK) guerrillas.

2. Vietnamese and PRK forces probably are using irritant agents against both the DK and Khmer Serei forces, especially along the Thai-Kampuchean border.

The possibility of a DK propaganda campaign is real. Of 76 CW attacks in Kampuchea reported between October 1978 and March 1980, 62 originated in DK propaganda broadcasts and press releases. Because the DK forces, unlike the H'Mong or the Afghan dissidents, remain under central control, the planting of other stories is possible. Five reports from DK informants were surfaced through the International Red Cross and Thai military. The remaining reports were provided by Thai intelligence, Khmer Serei forces, and PAVN defectors.

(b)(1)
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The Vietnamese have the means of delivering chemical munitions, but have no capability to produce the agents themselves. Lethal chemical agents would have to be supplied by the USSR; irritant agents would be either Soviet supplied or drawn from captured US supplies

(b)(3)

(b)(3)

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SECRET

USE OF TOXINS AND OTHER LETHAL CHEMICALS IN SOUTHEAST ASIA AND AFGHANISTAN

16 February 1982

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KEY JUDGMENTS

Laos

Lao and Vietnamese forces, assisted by Soviet logistics and supervision, have used lethal chemical agents against H'Mong resistance forces and villages, causing thousands of deaths since at least 1976. Trichothecene toxins have been positively identified as one of the classes of agents used, but medical symptoms indicate that irritants, incapacitants, and nerve agents also have been employed.

Kampuchea

Vietnamese forces have used lethal trichothecene toxins on Democratic Kampuchean troops and Khmer villages since at least 1978. Again, medical symptoms indicate that irritants, incapacitants, and nerve agents also have been used.

The Soviet Role in Southeast Asia

The one hypothesis that best fits all the evidence is that the trichothecene toxins were developed in the Soviet Union, provided to the Lao and Vietnamese either directly or through transfer of technical know-how, and weaponized with Soviet assistance in Laos, Vietnam, and Kampuchea. There is no intelligence at hand to support alternative explanations, such as completely independent manufacture and use by the Vietnamese. It is highly probable that the USSR also provided other chemical warfare agents. While the evidence on the Soviet role does not constitute proof in the scientific sense, the Intelligence Community finds the case to be thoroughly convincing.

Afghanistan

Soviet forces in Afghanistan have used lethal and casualty-producing agents on Mujahedin resistance forces and Afghan villages since the December 1979 invasion. There is some

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evidence that Afghan Government forces may have used chemical weapons provided by the USSR against the Mujahedin even before the invasion. No agents have been identified through sample analysis, but we conclude from analysis of all the evidence that attacks have been conducted with irritants, incapacitants, nerve agents, phosgene oxime, and perhaps trichothecene toxins, mustard, lewisite, and unidentified toxic smokes.

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DISCUSSION

Background

1. In September 1981 the US Government in a public declaration raised the probability that the trichothecene class of toxins*--poisonous chemical substances extracted from biological material (specific molds)--was the mysterious lethal agent that had been used for many years in Laos and Kampuchea. This significant statement was precipitated by the discovery of high levels of trichothecene toxins in a vegetation sample collected shortly after a March 1981 Vietnamese chemical attack in Kampuchea. That public declaration, however, rested on a much broader base of evidence than the analysis of that sample.

2. In April 1980 the Intelligence Community had already concluded that lethal agents had almost certainly been used against H'Mong tribespeople in Laos. There was less certainty about the use of lethal agents in Kampuchea, mainly because of suspicions about the propaganda campaign of Pol Pot's Democratic Kampuchean (DK) forces. The DK claims were subsequently shown to be valid. It was also concluded that chances were about even that lethal agents had been used in Afghanistan. There was little doubt by this time that riot control agents and some form of incapacitants had been used in all three countries. Since mid-1980, sufficient additional evidence has allowed a much firmer Intelligence Community judgment than that stated in the April estimate. There is now no doubt that deaths and casualties have resulted from chemical attacks in all three countries.

3. Analysis of additional samples from Laos and Kampuchea has revealed at least four trichothecenes, further supporting our conclusion that toxins were used. A review of all the reports indicates the use of many different chemical agents, means of delivery, and types of chemical attacks. In some cases, the symptoms are typical of those caused by trichothecenes, but in many cases the symptoms suggest other agents, which we have not been able to identify

* Trichothecene toxins, like all other toxins, are chemical compounds derived from biological material. For purposes of this assessment, toxins are characterized as chemical warfare agents. Their manufacture, however, would most likely take place in biological warfare facilities, even if the toxins were synthetically produced.

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through sample analysis. Significant differences as well as similarities have surfaced in the reports from the three countries. The evidence from each country, therefore, is described separately, with attention drawn to similarities where appropriate.

Methodology

4. The intelligence judgments of this study were arrived at through the following analytic process:

-- Every relevant piece of information on reported chemical warfare incidents was reviewed, recorded, and tabulated (see annex A). Numbers of attacks and deaths were screened for potential duplication. An extensive data base on the Soviet chemical and biological warfare program was also searched.

-- All the physical evidence available to the US Government--including environmental samples and background controls--was reviewed (see annex D).

-- A scientific report on toxins was prepared, including the analysis leading to the conclusion that trichothecenes were probably among the agents used in Southeast Asia. The report also documents the extensive toxin research conducted in the USSR (see annex D).

-- An analysis of the medical evidence was prepared, drawing on all available information from Southeast Asia and Afghanistan (see annex E). This incorporated the findings of the Department of Defense medical team (see annex C), which concluded that at least three types of agents were used in Laos.

-- Extensive consultations were held with government and nongovernment scientists and medical authorities, many of whom were asked to review our evidence. Experts from other countries were also consulted.

5. After the data base was organized to permit comparative analysis, the study focused on three separate questions:

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-- Have lethal and other casualty-producing agents been used in Southeast Asia and Afghanistan?

-- What are these agents and how and by whom are they employed?

-- Where do these agents originate and how do they find their way to the field?

6. Although the evidential base differs for each country, the analytic approach used was the same. The testimony of eyewitnesses--date, place, and type of attack--was matched against information from defectors, journalists, and international organizations and sensitive information that often pinpointed the time and place of chemical attacks. In addition, the intelligence files on military operations in the areas where chemical attacks had been reported were searched to establish whether air or artillery strikes took place or whether there was fighting in the areas where chemical agents were reportedly used. In all three countries, we identified a number of instances in which eyewitness accounts could be directly correlated with information from other sources.

7. There is no evidence of any systematic propaganda campaign having been mounted by the H'Mong or the Afghan resistance forces to promote the allegation that chemical agents have been used on their people. Rather it was the US Government, other governments, and private individuals from many countries that publicized the use of chemical agents and that provided the evidence to international organizations. On the other hand, there were early indications that Pol Pot's Democratic Kampuchean resistance did engage in an organized propaganda campaign on chemical agent use. These indications made us very cautious about accepting DK allegations, which increased markedly after the chemical attacks in Laos were publicized. For Kampuchea, therefore, we were particularly insistent in our efforts to confirm allegations made with sources of information that in no way could be part of a propaganda or deception campaign.

Laos

8. Reports of chemical attacks in Laos date from the summer of 1975 to the present. These reports describe 261 separate attacks in which at least 6,504 deaths were cited as having resulted directly from exposure to chemical agents.

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9. The actual number of deaths is almost certainly much higher, since the figure above does not take account of deaths in attacks for which no specific casualty numbers were reported. The greatest concentration of reported use of chemical agents occurred in the area where the three provinces of Vientiane, Xiangkhoang, and Louangphrabang adjoin (see map, figure 1). This triborder region accounted for 77 percent of the reported attacks and 83 percent of the chemical-associated deaths. Most of the reported attacks took place in 1978 and 1979. In the past two years, the incidence of chemical attacks appears to have been lower, but reported death rates among unprotected and untreated victims higher--only seven chemical attacks were reported in the fall of 1981, for example, but 1,034 deaths were associated with those incidents.

10. Evidently the fact that chemical agents were being used in Laos was not widely known among units of the Lao People's Liberation Army (LPLA). In June 1981, a group of refugees from a village in Vientiane Province reached Thailand and described attacks against them carried out a month earlier by helicopters ''dropping poison'' into their water supply. Lao field units that subsequently entered the village were surprised at the sight of many villagers still suffering from symptoms of acute poisoning. According to the villager, when the Lao military personnel saw the ''small yellow grains'' spread around the village, they were convinced that toxic chemicals had been used on the village and requested medical assistance for those villagers still suffering from nausea and bloody diarrhea.

11. In a 15 December 1981 press conference in Beijing, former Lao Health Ministry Bureau Director Khamsengkeo Sengsthith--who had defected to China--claimed that the Vietnamese were using chemical weapons ''in the air and on the ground'' in Laos, killing ''thousands.'' He asserted that the Vietnamese alone were using such weapons, keeping the matter secret from the Lao. He also stated that 3,000 Soviet advisers are in Laos and ''have taken control'' of the Lao Air Force, while 40,000 to 50,000 Vietnamese troops have reduced Laos to the status of a colony.

12. Obtaining corroborative data for Laos has been difficult simply because of the nature of the fighting there. There have been few major operations. Rather, the reports

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reflect numerous minor engagements between the opposing forces, and results of these encounters are rarely reported. This is consistent with the observation that the resistance forces are splintered, operating in small, discrete units that emphasize sabotage and unconventional warfare. Finally, in nearly all cases, the chemical use reported has been directed against villages, in the absence of obvious combat operations. This substantiates a Lao pilot's claim that the Vietnamese and Laotian military commands were engaged in a ''H'Mong extermination.'' campaign.

13. Of particular interest are the circumstances surrounding the collection of two physical samples that were found to contain lethal toxins. The first sample was collected after a 13 March 1981 attack on a village between the villages of Muony Chai and Phakhao in the Phou Bia region. In this case, a large two-engine plane reportedly sprayed a mist of a moist, yellow, sticky substance; two villagers and all village animals died. The second sample is from Ban Thonghak, another village in the Phou Bia region. That sample was collected following a 2 April 1981 attack in which an jet aircraft reportedly sprayed a yellow substance; 24 of the 450 villagers died. Seven separate chemical attacks, resulting in 218 deaths, were reported to have occurred in this region in the spring of 1981.

14. It is significant that these attacks took place following a period of escalation in overall resistance activities in the Phou Bia area in the winter of 1980-81. During that period, suppression operations by LPLA and Vietnamese Army (PAVN) forces had achieved only limited success, perhaps spurring both forces on to greater effort. The more intense use of chemical weapons may have been part of this effort.

15. Every qualified interrogator who systematically interviewed the H'Mong refugees concluded that the latter had been subjected to chemical attacks. For example, the US Government medical team returned from Thailand in 1979 convinced that several unidentified chemical warfare agents had produced the symptoms described by the refugees. It was the testimony of a Lao pilot who flew the chemical warfare missions that helped dispel any lingering suspicions that the refugees had fabricated or embellished the stories. His detailed description of the Lao, Vietnamese, and Soviet program to defeat the H'Mong resistance with chemical agents appears in annex B.

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16. The Lao pilot described the chemical rocket he had fired as having a more loosely fitting warhead than a conventional rocket. In 1977 a H'Mong resistance leader found a US 2.75-inch rocket with a modified Soviet warhead that fits this description. In further corroboration, other sources reported that US 2.75-inch rockets were fitted with lethal chemical warheads by Soviet and Vietnamese technicians at facilities in three Laotian provinces. Munitions storage facilities suitable for storing chemical agents and weapons have been identified in each of these provinces. The aircraft types--L-19s, T-41s, T-28s, and AN-2s--most often reported by the H'Mong refugees as being used to deliver chemical agents have been identified as based on airfields in northern Laos throughout this period.

Kampuchea

17. For Kampuchea we have reports of 124 separate attacks, from 1978 to the present, in which lethal chemicals caused the deaths of 1,014 individuals. Here again, the mortality figure represents a minimum because some reports state only that there were deaths and do not provide a number. The earliest reports cite attacks in Ratanakiri Province, in the northeastern corner of the country (see map, figure 2). Reports from 1979 to the present show the use of lethal chemicals primarily in the provinces bordering on Thailand. The greatest use of chemical agents apparently has been in Battambang Province (51 reported incidents); Pursat Province has suffered the next highest frequency, with 25 reported incidents. These numbers are consistent with the overall high level of military activity reported in the border provinces.

18. A review of reports from all sources provides specific support for 28 of 124 reported attacks. There is, in addition, some circumstantial evidence that in all reported instances some form of attack took place. This evidence includes reports of troop movements, supply transfers, operational plans, postoperation reporting, and air activity reports. It indicates that military activity took place at the time and place of every incident reported to involve lethal chemical agents. In some cases, it provides strong circumstantial indications that the action involved chemical substances--for example, the movement of chemicals and personal protection equipment in the area.

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19. US analysis of contaminated vegetation samples from a March 1981 attack showed high levels of three trichothecene toxins in a combination that we would not expect to be found in a natural outbreak in this environment. These three trichothecenes at the levels found on the vegetation would produce the vomiting, skin irritation and itching, and bleeding symptoms. Water samples taken from the area of the same attack also contained trichothecene toxins. Control samples from nearby areas confirmed that these toxins are not indigenous to the locale. (Details on the sample analysis appear in annex D.)

20. There is also ample evidence of military activity at the place and time of the acquisition of the samples. PAVN defectors described plans for multiregimental sweep operations to be conducted along the border in north-western Battambang Province before the end of the dry season in May. Actual fighting, however, continued to be characterized by guerrilla tactics on both sides, including, according to one PAVN defector, ''staging ambushes, laying minefields, and use of deception.'' Indeed, DK forces were ordered to avoid large-scale operations, to limit combat operations to scattered sapper attacks. Such information is consistent with other reports of PAVN forces spreading toxic chemicals along streams and roadsides and around villages, and firing toxic gas shells against enemy positions. In sum, the Phnom Melai sector (in which Phnom Mak Hoeun is located) was described as an ''anthill of DK activity,'' and actions reported during March were ''sporadic firefights'' around Phnom Mak Hoeun involving PAVN forces.

21. In Kampuchea as in Laos, the period of late 1980 through spring 1981 was one of intensified Vietnamese operations to suppress the resistance, and the Vietnamese may have considered the use of toxins an effective means of breaking the will of the opposing forces.

22. Additional supporting evidence was derived from blood samples drawn from victims of PAVN chemical use that reportedly occurred on 19 September 1981 in the Takong area. (Blood analysis appears in annex E.) Takong is in the same general area as Phnom Mak Hoeun--that is, the central region of the Battambang Province - Thailand border. Again, there is no independent confirmation of the accounts of the attacks, but medical personnel visiting the DK field hospital examined the victims and obtained blood samples. Analysis of these samples suggested the use of tricothecenes.

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23. The chemicals used in the 19 September Takong attack were dispersed (according to the DK soldiers affected) as a gas or powder, and as a poison to water. The gas or powder was released from containers by tripwires in the area of the rear forces. This description is consistent with the other reporting in this area and time.

24. In sum, substantial evidence on the Vietnamese use of chemical weapons existed before the discovery of trichothecene toxins in vegetation and water samples. We share the Thai's concerns about chemical attacks against their own people, especially after one Thai died and others became ill from Vietnamese poisoning. In May 1981 the Thai captured two Vietnamese in the act of poisoning water with cyanide in a Thai relocation camp. A number of reliable reports indicate that it is common practice for PAVN units to poison water and food used by the DK forces.

Afghanistan

25. Attacks with chemical weapons against the Mujahedin guerrillas in Afghanistan were reported as early as six months before the Soviet invasion on 27 December 1979. The reports specify only that Soviet-made aircraft were used to drop chemical bombs, with no clear identification of Soviet or Afghan pilots, or of the specific agents used. A number of Afghan military defectors stated that the Soviets provided the Afghan military with chemical warfare training as well as supplies of lethal and incapacitating agents.

26. For the period from the summer of 1979 to the present, we have reports of 43 separate chemical attacks with more than 3,000 chemical-associated deaths (see map, figure 3). Ten separate chemical attacks, killing considerable numbers of persons, were reported in the first three months of 1980. All of the reports came from northeastern Afghanistan and provide the highest percentage of reported deaths. By the spring and summer of 1980, chemical attacks were reported to have occurred in all areas of concentrated resistance activity. Reports of chemical weapon use in 1981 essentially parallel 1980 reporting with respect to frequency and location of attack. Of the 43 chemical attack reports, 36 have come from human sources, including Afghan Army deserters, Mujahedin resistance fighters, journalists, and US physicians. For 24 of the reported 43 attacks we have additional independent evidence supporting allegations of chemical attacks. In seven instances we have additional

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human reporting. For example, an Afghan insurgent provided an eyewitness account of a 6 July 1980 attack on a village 10 kilometers east of Darae Jelga in Vardak Province. The insurgent reported that a Soviet MI-24 helicopter gunship dropped a bomb that, upon explosion, released a lethal chemical. A separate report from a reliable source confirmed that Soviet aerial bombing attacks were taking place during this period on villages in Vardak (as well as Lowgar and Parvan Provinces.)

27. Support for 20 of the reported incidents comes from information on Soviet or Afghan Army combat operations that were in progress in areas at times approximating those of a reported chemical attack. In a few cases, reporting is quite specific. The following sequence, for example, occurred in a small valley in Qandahar Province in early June 1981: Soviet combat groups engaged rebel forces in that valley during a two-week period, according to an Afghan exile. The situation worsened for the Soviets and an airstrike was conducted. The Afghan exile reports that a Soviet helicopter delivered a single rocket, which released a chemical that killed 16 insurgents. Nearly all reports state that chemicals were delivered by aircraft or helicopters, with a few reports describing chemical artillery rounds.

28. Many reports from different sources strongly support the use of irritants to drive the insurgents into the open to expose them to attack with conventional weapons, and incapacitants to render them tractable for disarming and capture. On several occasions in April 1980, for example, Soviet helicopter pilots dropped ''gas bombs'' on insurgents, evidently to drive them from caves.

29. Victims of Soviet attacks, conducted to flush them from caves, describe symptoms that cannot be associated with riot control agents like CN and CS or even Adamsite. Medical examinations of some of the victims include reports of paralysis, other neurological effects, blisters, bleeding, and sometimes death. While none of the agents being used in Afghanistan have been positively identified through sample analysis, it seems clear that the agents being used are far more toxic than the irritants cited above.

30. Afghan military defectors have provided lists of the Soviet agents stockpiled in Afghanistan and described where and when some of them have been used. The list

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included nerve agents, phosgene, phosgene oxime, sulfur mustard, nitrogen mustard, and lewisite. The agents used, plus the time and location of the attacks, generally correspond to the refugee reports and recorded military operations. Afghan military defectors have also pinpointed where they are stored.

31. Soviet operational personnel decontamination stations were observed at two locations in Afghanistan and a chemical decontamination field unit was deployed during a sweep operation of the Konar Valley in 1980. In addition, Soviet personnel have been observed wearing chemical protective equipment. At Shindan, TMS-65 decontamination units were deployed in a classical operational mode. This suggests that the chemical battalions have performed an operational role in Afghanistan connected with offensive chemical use. A Soviet chemical specialist told an American news correspondent that his mission was to examine villages after a chemical attack to determine whether it was safe to enter or required decontamination. An Afghan pathologist who defected described how he accompanied Soviet chemical warfare personnel into contaminated areas to collect soil, vegetation, and water samples after Soviet chemical attacks. The Soviets, according to firsthand experience of former Soviet chemical personnel, do not require decontamination equipment in an area where chemical bombs are stored or loaded on aircraft. We thus associated the deployment of this equipment in Afghanistan with the active employment of casualty-producing chemical agents.

32. In sum, the eyewitness testimony of Afghan refugees and journalists about chemical warfare activities is supported by defectors, as was the case in Laos and Kampuchea. Other evidence supports the judgment that chemical agents have been used and that Afghan and Soviet military operations took place in almost every area where we have reports of chemical attacks.

What Chemical Agents Are Being Used?

33. The specific chemical agents being used in Laos, Kampuchea, and Afghanistan cannot be determined without collection and analysis of at least one of the following: environmental samples contaminated with agent, the munitions used to deliver agents, or biological specimens from victims of an attack. A study by medical-toxicological experts of symptoms exhibited by individuals exposed to toxic agents does provide a good indication of the general

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class of chemical agent used. Thus, the range of clinical manifestations from chemical agents as reported by a US Army investigative team resulted in the determination that nerve agents, irritants such as CS, and a highly toxic hemorrhaging chemical or mixture of chemicals were used in Laos. Other medical-toxicological personnel arrived at the same determination and further indicated that toxins such as the trichothecenes were a probable cause of the lethal hemorrhaging effect seen in Kampuchea as well as Laos. Symptoms reported by the DK in Kampuchea and the Mujahedin in Afghanistan were in many cases similar to those reported by the H'Mong in Laos. In addition, symptoms reported from Afghanistan and Kampuchea indicated that a highly potent, rapid-acting incapacitant ''knockout'' chemical also was being used. Mujahedin victims and witnesses to chemical attacks reported other unusual symptoms, including a blackening of the skin, severe skin irritation with multiple small blisters and severe itching, severe eye irritation, and difficulty in breathing--suggesting that phosgene oxime or a similar substance was used.

34. Collecting samples possibly contaminated with a toxic agent during or after a chemical assault is difficult under all circumstances but particularly when the assault is against ill-prepared people without gas masks and other protective equipment. Obtaining contaminated samples that will yield positive traces of specific chemical agents is dependent on a number of factors. These include the persistency of the chemical, the ambient temperature, rainfall, wind conditions, the media on which the chemical was deposited, and the time, care, and packaging of the sample from collection to analysis in a laboratory. Many standard chemical warfare agents are nonpersistent and disappear from the environment within a few minutes to several hours after being dispersed. These include, for example, the nerve agents Sarin and Tabun; the blood agents hydrogen cyanide and cyanogen chloride; the choking agents phosgene and diphosgene; and the irritant phosgene oxime. Other standard CW agents--such as the nerve agents VX and thickened Soman and the blistering agents sulfur mustard, nitrogen mustard, and lewisite--may persist for several days to weeks depending on weather conditions. The trichothecene toxins have good persistency but may be diluted to below detectable concentrations by adverse weather conditions. To maximize the chances of detection, sample collections should be made as rapidly after a chemical assault as possible, and with many agents this means minutes

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to hours. Under the circumstances of Southeast Asia and Afghanistan this has simply not been possible. While numerous samples were collected, few of them held any realistic prospect of yielding positive results. It is fortunate that trichothecenes are sufficiently persistent to allow detection several months after the attack.

35. Samples have been collected from Southeast Asia since mid-1979 and from Afghanistan since May 1980. To date about 50 individual samples--of greatly varying types and usefulness for analytical purposes--have been collected and analyzed for the presence of traditional CW agents, none of which have been detected. On the basis of recommendations by medical and toxicological experts and of findings by the CSL, many of the samples have been analyzed for the trichothecene group of mycotoxins. Four samples, two from Kampuchea and two from Laos, were found to contain high levels of trichothecene toxins. Preliminary results of the analysis of blood samples drawn from victims of an attack indicate the presence of trichothecene (T-2) metabolite, but quantification of their levels is pending.

36. The accompanying table lists the chemicals and their probability of use in Afghanistan by Soviet and, in Southeast Asia, by Vietnamese and Laotian forces. The judgments shown in this table are based on sample analysis, on collateral and special intelligence, and on medical and toxicological evaluations.

Soviet Chemical Warfare Activities

37. Evidence accumulated since World War II clearly shows that the Soviets have been extensively involved in preparations for large-scale offensive and defensive chemical warfare. We have identified the chemical warfare agents and delivery systems they have developed, probable production and storage areas within the USSR, and continuing research, development, and testing activities at the major Soviet chemical proving grounds. None of the evidence indicates any abatement in this program. The Soviets have shown a strong interest in improving or enhancing their standard agents for greater reliability and effect. Their large chemical and biological research and development effort has led them to investigate other kinds of CW agents, particularly the toxins. A bibliography on Soviet research in the toxin field is included in annex D.

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Degrees of Confidence in Identification of Specific Classes of Chemicals Used in Southeast Asia and Afghanistan[a]

	Laos	Kampuchea	Afghanistan
Trichothecene toxins	Confirmed	Confirmed	Suspected
Nerve agents	Probable	Probable	Probable
Irritants	Probable	Probable	Probable
Vesicants and urticants	Suspected	Suspected	Probable
Incapacitants	Suspected	Probable	Probable

[a] The confidence levels shown refer to the identification of specific chemicals used, not to the probability that some form of lethal chemical was used. We consider the latter a certainty.

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38. To our knowledge, none of the four countries--Vietnam, Laos, Kampuchea, and Afghanistan--has any large-scale facility or organization for the manufacture of chemical and biological materials. Nor are they known to have produced even small quantities of chemical warfare agents or munitions. The technical problems of producing large quantities of weapons-grade toxin, however, are not so great as to prevent any of the four countries from learning to manufacture, purify, and weaponize these materials. It is highly unlikely, however, that they could master these functions without acquiring outside technical know-how. The only country known to be providing chemical warfare assistance to these countries is the Soviet Union.

39. The Soviets have had advisers and technicians working in Vietnam, Laos, and Kampuchea for many years, but not until early 1979 did evidence connect the Soviet military directly with chemical warfare activities. The evidence is quite conclusive. For example, in early 1979, Soviet military personnel inspected chemical storage facilities in Paxse. The chemicals inspected were reportedly those that cause ''stomach sickness and death.'' This important piece of evidence was supported by several reliable reports that provided more detail on the mid-February visit and on another Soviet inspection by chemical warfare experts in June 1979.

40. Another reliable report stated that the chemical section in one Lao province prepared Soviet-manufactured chemical items for inspection by a Soviet military team in early 1979. A seven-man team of Soviet chemical artillery experts, accompanied by Laotian chemical officers, inspected chemical supplies and artillery rounds at the Xeno storage facility in mid-1979. One report stated that the Soviet team would be inspecting the same chemical explosives used to suppress the H'Mong resistance in the Phou Bia area.

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CONCLUSIONS

Laos. We conclude from all the evidence that selected Lao and Vietnamese forces, under direct Soviet supervision, have employed lethal trichothecene toxins and other combinations of chemical agents against the H'Mong resistance forces, including their villages, since at least 1976. Thousands have died, have been severely injured, or were driven from their homeland by the use of these agents.

Kampuchea. The evidence strongly supports the conclusion that the Vietnamese have similarly been using lethal trichothecene toxins and other combinations of chemical warfare agents on Democratic Kampuchean forces and other resistance groups since at least 1978.

Afghanistan. We conclude that Soviet forces in Afghanistan have used a wide variety of lethal and nonlethal chemical agents on Mujahedin resistance forces and Afghan villages since the Soviet invasion in December 1979. Afghan Government forces probably used chemical weapons before the Soviet invasion, but we cannot identify the types of agents used. It has not been possible to identify the agents used by the Soviets through sample analysis, but a number of Afghan military defectors have named the agents brought into the country and have described where and when they were used. That information has been correlated with all other evidence, including the reported symptoms. We conclude that nerve agents, phosgene oxime, and various incapacitants, and irritants have been used. Other agents and toxic smokes are also available in country, but we cannot state confidently that they have been used. Some of the reported symptoms are consistent with those produced by lethal or sublethal doses of trichothecene toxins, but our evidence is not conclusive.

The Soviet Role. We conclude that the Soviets either provided the toxin weapons directly or provided the toxins for weaponization in Vietnam and Laos. A common practice in the Soviets' own military forces is to store agents in bulk and move them to the field for munitions fill as needed. Our assumption that this practice is also followed in Indochina and Afghanistan is supported by a number of reports, which specify that Soviet technicians supervise the shipment, storage, filling, and loading on aircraft of the chemical munitions. The dissemination techniques reported

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and observed are evidently drawn from years of Soviet chemical warfare testing and experimentation. No intelligence is at hand to support any alternative explanation, but we cannot completely rule out the possibility that Soviet technical assistance has enabled at least the Vietnamese to conduct an indigenous toxin production program.

Motivation for Chemical Weapons Use. In the course of the analysis, we have posed the question: ''Is there a military-strategic or tactical rationale for the systematic use of chemical weapons in Laos, Kampuchea, and Afghanistan?'' We conclude that the military problems faced in all three countries--as viewed from the perspective of the Soviets and their allies--make the use of chemical weapons a militarily effective way of breaking the will and resistance of stubborn guerrilla forces operating from relatively inaccessible protected sanctuaries. These weapons offer substantial advantages over conventional weapons. In all three countries the resistance was able through conventional means to frustrate Soviet and client-state objectives of extending and consolidating control over the countries attacked. The Soviets probably reasoned that attainment of these objectives--as quickly and cheaply as possible--justified use of chemical weapons and outweighed a small risk of exposure and international condemnation. They may well have calculated that they and their allies could successfully deny or counter charges that chemical weapons had been used, recognizing that it would be most difficult to compile incontrovertible evidence from inassessible areas of Southeast Asia and Afghanistan. In addition, the Soviet military very likely consider these remote areas as providing unique opportunities for the operational testing and evaluation of chemical weapons under various tactical conditions.

We found support for this conclusion from Third World officers who had attended the Soviet Military Academy of Chemical Defense in Moscow. According to their Soviet instructor, three types of chemical agents may be used during the ''initial stages'' of local wars: ''harassing agents (CS, CN, DM), incapacitants such as psychochemicals (BZ) or intertoxins [sic (possibly enterotoxins)], and herbicides.'' During the ''decisive phase, lethal agents can be employed under certain circumstances.'' In a ''local war, chemical weapons can be used to spoil enemy efforts to initiate operations, even if the enemy has not used them first.'' The foreign officers' accounts, including detailed descriptions of the Soviet chemical warfare program, supports the conclusion that the Soviets consider chemical weapons an effective and acceptable means of warfare in local conflicts.

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Annex A

Tabulations of Reported Chemical Warfare Attacks in Laos, Kampuchea, and Afghanistan

This annex comprises three tables summarizing chronologically, by location, number, and associated deaths, the chemical attacks reported to have occurred in Laos, Kampuchea, and Afghanistan between 1975 and 1981. The tables were compiled from a large volume of intelligence reports on such attacks. Every effort was made to correlate individual allegations with collateral information and to eliminate double counting. The number of fatalities shown almost certainly fall short of actual totals, because our coverage is inevitably incomplete, and many reports failed to provide casualty numbers.

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Table A-1

Laos: Summary of Reported Chemical Attacks and Associated Deaths, 1975-81

Time Period	Area	Attacks[a]	Deaths[b]
Summer 1975	Vientiane	2	25+
Fall 1976	Phou Bia	8	10
	Savannakhet	1	10
Winter 1976-77	Phou Bia	2	16
Spring 1977	Phou Bia	6	66+
	Khammouan	2	1
Summer 1977	Phou Bia	6	95
Fall 1977	Phou Bia	1	25
Winter 1977-78	Phou Bia	10	1,328+
	Savannakhet	6	224
Spring 1978	Phou Bia	34	969+
Summer 1978	Phou Bia	22	664+
Fall 1978	Phou Bia	19	572
Winter 1978-79	Phou Bia	5	15+
Spring 1979	Phou Bia	36	257+
Summer 1979	Phou Bia	5	239+
Fall 1979	Phou Bia	10	56
	Xaignabouri	2	24+
Winter 1979-80	Phou Bia	4	10+
Spring 1980	Phou Bia	3	24
Summer 1980	Phou Bia	6	187+

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Table A-1 (continued)

Time Period	Area	Attacks[a]	Deaths[b]
Fall 1980	Xaignabouri	1	12
	Phou Bia	7	88+
	Savannakhet	3	1+
Winter 1980-81	Xaignabouri	2	57
	Phou Bia	4	82
	Vientiane (SE)	1	1+
Spring 1981	Houaphan	2	?
	Phou Bia	7	218
	Vientiane (S)	1	--
Summer 1981	Phou Bia	1	?
Fall 1981	Phou Bia	4	500+
	Khammouan	3	534+
		226	6,310+

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a This tabulation omits 35 attacks, accounting for 194 deaths, that were not located in the reports. The totals overall were 261 attacks and more than 6,504 deaths.

b A plus sign indicates that the report(s) of deaths gave a minimum figure. In some cases (shown with a question mark) deaths were reported, but no number was given. Other reports (signified with a dash) gave no information on fatalities.

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Table A-2

Kampuchea: Summary of Reported Chemical Attacks and Associated Deaths, 1978-81

Time Period	Area	Attacks	Deaths[a]
1978	Ratanakiri	5	?
Summer 1979	Kampong Speu	4	37
Fall 1979	Siem Reap	1	--
	Battambang	4	22+
	Pursat	2	1+
	Koh Kong	2	6+
	Kampot	1	3
	Kampong Chhnang	2	118
Winter 1979-80	Battambang	12	64+
	Pursat	5	21+
	Koh Kong	2	4
Spring 1980	Battambang	3	20+
	Pursat	8	24+
	Koh Kong	5	13
Summer 1980	Siem Reap	1	82+
	Battambang	3	23+
	Pursat	2	7
	Koh Kong	3	--
Winter 1980-81	Battambang	8	--
	Pursat	2	3
Spring 1981	Preah Vihear	1	--
	Battambang	12	163+
	Pursat	3	42+
	Koh Kong	1	--
	Kampot	1	--
Summer 1981	Battambang	3	7+
	Kampong Thom/Cham	1	--

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Table A-2 (continued)

Time Period	Area	Attacks	Deaths[a]
Fall 1981	Siem Reap	16	305
	Battambang	6	16
	Pursat	3	--
	Koh Kong	1	--
	Kampot	1	--
		124	981

[a] A plus sign indicates that the report(s) of deaths gave a minimum figure. In some cases (shown with a question mark) deaths were reported, but no number was given. Other reports (signified with a dash) gave no information on fatalities.

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Table A-3

Afghanistan: Summary of Reported Chemical Attacks and Associated Deaths, 1979-81

Time Period	Province	Attacks[a]	Deaths[b]
Summer 1979	Badakhshan	1	2,000
	Parvan	1	8
	Bamian	1	--
Fall 1979	Konarha	1	350
	Farah	1	?
	Herat	1	?
	Badghisat	1	?
Winter 1979-80	Badakhshan	5	130+
	Takhar	1	--
	Konarha	2	10+
	Nangarhar	1	?
	Bamian	1	?
Spring 1980	Badakshan	1	1+
	Konarha	2	?
	Oruzgan	1	--
	Qandahar	1	--
Summer 1980	Nangarhar	2	1
	Vardak	1	3
	Herat	2	300+
	Kabul	2	--
Fall 1980	Konarha	1	?
	Lowgar	1	4
	Ghazni	1	100
Winter 1980-81	Lowgar	2	?
Spring 1981	Parvan	2	--
	Lowgar	3	--
	Ghazni	2	?
	Qandahar	1	--
Summer 1981	Nangarhar	2	?
	Qandahar	2	16
	Herat	1	119
		47	3,042

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[a] This tabulation omits some attacks described in the text because they could not be dated or located with high confidence.

[b] A plus sign indicates that the report(s) of deaths gave a minimum figure. In some cases (shown with a question mark) deaths were reported, but no number was given. Other reports (signified with a dash) gave no information on fatalities.

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ANNEX B

A LAO PILOT'S STORY

The most complete description of the period 1976-78 came from a Lao pilot who was directly involved in chemical warfare. The pilot, a former LPLA officer who defected in 1979, reported that he flew L-19 and T-41 aircraft equipped to dispense toxic chemical agents on H'Mong villagers in the Phou Bia area of northern Laos. He said that the LPLA, in cooperation with the PAVN, had conducted CW operations in Laos since April or early May 1976. At that time, two LPLA H-34 helicopters conducted a series of shuttle flights transporting rockets to an airfield in Xiangkhoang Province.

Between June and August 1976 the LPLA launched attacks in the area of Bouamlong--in Xiangkhoang Province--that was a stronghold for remnants of the forces of former H'Mong Gen. Vang Pao. The LPLA used L-19 aircraft for rocket attacks in that area aimed at eliminating the H'Mong resistance. LPLA crews responsible for loading rockets on the attack aircraft noted, however, that they were not allowed to use the rockets that had been moved from Long Tieng to Phonsavan, even though Phonsavan was much closer to the Bouamlong target area than Long Tieng, where LPLA aircraft had to rearm. The pilot said that, during nearly three months of flying missions against the Bouamlong area, he flew his L-19 aircraft to Long Tieng to be armed with rockets.

In late 1976 the pilot's L-19 aircraft was rearmed with rockets stored at Phonsavan. Initially, H-34 helicopters were used to transport the rockets from Phonsavan to a depot near the Ban Xon airfield, Vientiane Province, where they were fitted onto racks of the L-19 aircraft for missions in the Phou Bia area. Later, the rockets from Phonsavan were transported to Ban Xon by trucks. All US-manufactured rockets were stored with the tip and canister kept apart; in other words, the two parts had to be joined before being fitted to the racks on the aircraft. The pilot observed, however, that all the rockets transported from Phonsavan to Ban Xon were already assembled.

As part of his routine flight activities, the pilot would check over his aircraft and, in doing so, examine the tip portion of new smoke rockets that had been transported from Phonsavan. He said that most of them appeared ''loose''

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in the portion where the tip and canister joined, whereas the tip and canister of the ordinary explosive-type rockets at Long Tieng were noticeably more tightly connected.

In late 1976, preparation for airstrikes on Kasy (Louangphrabang Province) and in new areas of Phou Bia, the pilot said he began carrying two or three PAVN staff officers, sometimes accompanied by an LPLA staff officer, in T-41 aircraft for reconnaissance over the target areas. When these airstrikes were launched, the defector pilot initially flew his L-19 aircraft on missions with another pilot and an LPLA staff officer sitting in the rear seat. After two or three weeks, however, PAVN staff officers, who spoke excellent Lao, began alternating in the rear-seat role with the LPLA officers. Before each mission, the PAVN or LPLA staff officer would go over target areas outlined on situation maps--which then were taken along--and would point out the targets to be attacked. The source noted that at no time did the PAVN staff officer sitting in the back seat of his aircraft communicate with LPLA officers on the ground, as did the LPLA staff officers. A new PAVN officer was used on each mission always assigned for each of the T-41 reconnaissance and L-19 airstrike missions in the H'Mong areas. The average age of these PAVN staff officers was midfourties.

The source related that before flying L-19 airstrike missions with a full load of rockets he was often warned by an LPLA commander to fly at above-normal altitudes when firing rockets to preclude hazard to the occupants of the aircraft. For this reason the pilot surmised that the ''smoke'' rockets fired at the H'Mong people were unusual. He was able to observe that the ''smoke'' rockets detonated in the air and that some produced white smoke with a mixture of blue, while others produced red smoke with a mixture of yellow. The ordinary, explosive-type rockets detonated on impact. The commander or his designated representative told the pilot before every mission that the operations--called Extinct Destruction Operations--were intended to ''wipe out'' the reactionary H'Mong people.

Before a mission involving ''smoke rockets,'' the commander warned the pilots to keep the operation secret. The source said that, during the nearly two years in which he flew rocket missions, he learned from the LPLA staff officers accompanying him that there were two types of rockets. The first, mostly ''smoke'' rockets, were to be fired at targets far away from LPLA and PAVN troops to avoid exposing them

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to the poison smoke. The second was of the ordinary explosive type, considered a ''close support'' rocket that could be fired near LPLA and/or PAVN troop positions. Initially, the L-19 aircraft carried eight rockets--five ''close support'' and three ''smoke'' rockets. Later, only four rockets, mainly of the ''smoke'' type, were carried.

After each mission in which chemical warfare rockets were used, the pilot was returned to a ''rest house'' at Phonsavan, where an LPLA doctor and nurse would examine him. He said that after his missions, especially in 1978, he was particularly well treated by the examining doctor and watched very closely by the LPLA nurse. Those L-19 aircraft pilots assigned to missions utilizing chemical warfare rockets had special privileges, including additional flight pay and free meals at the Phonsavan cafeteria. In October 1978 the LPLA stopped using L-19 aircraft on combat missions and began using Soviet MIG-21s for chemical attacks on the Phou Bia areas.

Corroborating Evidence. Several H'Mong reports provide significant substantiation of the testimony of the Laotian pilot. The chief of eight villages, for example, described attacks covering all seven days of the week of 5 June 1976 in the Bouamlong area, Xiangkhoang Province. He described L-19 aircraft firing rockets that produced red and green smoke. Ten villagers were killed by gas and 30 by shrapnel. Most of the H'Mong reports documented by a US foreign service officer in June 1979 and a Department of Defense medical team in October 1979 are consistent with the Laotian pilot's testimony. H'Mong observers familiar with military aircraft reported L-19s until late 1978. After that time, reports described jets or ''MIGs'' and some accurately described Soviet AN-2s.

A review of information back to 1975 shows L-19 and T-28 or aircraft were operating from airfields in northern Laos--including the one at Phonsavan, where AN-2s were seen in 1978. Our failure to observe chemical decontamination equipment at the airfields, moreover, does not rule out the handling of chemical munitions. The Soviets supervise the chemical warfare activities in Laos; we assume, therefore, that chemical munitions are handled in about the same manner as in the USSR. No protective clothing or special decontamination equipment is required for loading chemical bombs on aircraft and helicopters at chemical munitions test ranges, according to former Soviet chemical warfare personnel.

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The Laotian pilot's description of the rockets used on the L-19 was corroborated by other sources. An H'Mong refugee, a former commmander of a 500-man resistant force, reported that in 1977 he found a rocket canister and a separated warhead that he believed were the kinds used by the Vietnamese and Laotians. The canister, he said, had authentic US markings identifying it as a US-manufactured 2.75-inch rocket, as well as reportedly three lines of Russian writing (which he could not translate). Another H'Mong source, who reportedly had been trained as a liaison officer and ordnance expert before the Communist takeover of Laos in 1975, stated that he too believed the rocket canister was of US manufacture and that the Soviet technicians in Laos had modified the upper stage to contain a poisonous (lethal) chemical.

The diameter of the warhead was reported to be 12.5 centimeters (5 inches), probably a measurement taken on a modified warhead because the United States does not have a 5-inch warhead for the 2.75-inch ''rocket motor.'' During the Vietnam conflict, about 35 million US-manufactured, conventional 2.75-inch rockets were sent to the war zone, and many tens of thousands of these no doubt fell into North Vietnamese hands when South Vietnamese forces collapsed. The Vietnamese may be using some of these rockets with existing loads, but modified warheads for the 2.75-inch rocket motor could easily be fabricated in Vietnam and filled with a lethal or nonlethal agent in Laos, especially with Soviet assistance. According to US experts, fabrication of a warhead 5 inches in diameter, necked down to fit the 2.75-inch rocket, could be accomplished by trained technicians in a small, well-equipped machine shop and laboratory.

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Annex C

Final Report of DASG Investigative Team: Use of Chemical Agents Against the H'Mong in Laos

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From 28 September to 12 October 1979 a team from the office of The Surgeon General was in Thailand to investigate allegations of the use of chemical agents against H'Mong tribesmen in Laos.

The team visited the following H'Mong refugee camps of northern Thailand: the detention center at Nhong Khai, the large H'Mong camp at Ban Vanai, and two smaller camps at Nam Yao and Mae Charmin. As the great majority of refugees as well as the H'Mong leadership are at Ban Vanai most of the interviews were obtained there.

Entrance and exit briefings concerning the team's mission were held at the US Army Biomedical Laboratory, Aberdeen Proving Ground; the State Department, Washington, D.C.; the U.S. Embassy, Bangkok; the Thailand Army Surgeon General; refugee camp officials, as well as the U.S. Army Surgeon General and Assistant Chief of Staff for Intelligence.

The team was prepared to obtain blood and skin samples (for cholinesterase activity and study of pathological changes respectively) from those exposed to chemical agents. For such samples to yield meaningful results they must be taken within 6-8 weeks of exposure. Since the last reported exposure was in May 1979 no samples were collected.

Interviews were conducted through interpreters; one interpreter was an employee of the U.S. Consulate at Udorn, and the remainder were hired from among the refugees. The interpreters screened those refugees who volunteered to talk to the team and selected only those who had or been eyewitnesses to or had themselves been exposed to an agent attack. Team members interviewed 40 men, 2 women, and a 12 year old girl. Each interview took 1-2 hours. To achieve conformity a prepared questionnaire was used as a guide.

The chemical attacks reportedly occurred between June 1976 and May 1979 (table C-1). The absence of reports of attacks after May 1979 may be because very few refugees crossed the Mekong River after that time because of heavy rains and flooding from June to September 1979. Most of the early reports were of the use of rockets releasing the agent, but beginning in the fall of 1978 the majority of the attacks were carried out by aircraft spraying a yellowish substance which ''fell like rain.'' The sites of the attacks, which were concentrated around the H'Mong stronghold in the mountainous Phou Bia area, are also listed in table C-1.

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The team was given a plastic vial containing pieces of bark stained by a yellow substance which several H'Mong refugees claimed was residue from an aircraft spray attack in April 1979. Preliminary chemical analysis of the sample indicates that no standard chemical agent is present, i.e., an agent listed in TH 8-285 (U.S. Army, May 1974). A complete report of this analysis will be submitted upon completion of further studies.

A similar series of interviews was conducted by State Department Officials in June 1979. From the signs/symptoms described and observed the following is suggested:

1. At least two, and possibly three, different chemical agents may have been used, such as:

(a) A nerve agent (five or six individuals reported symptoms that could be attributed to a nerve agent).

(b) An irritant or riot control agent (1/3 of the interviews).

(c) Over half of the interviews indicated such a variety of signs and symptoms that it is difficult to attribute them to a single known agent.

2. It is possible that in some cases, two or more agents were combined.

(a) Reported signs and symptoms suggesting a nerve agent include sweating, tearing, excessive salivation, difficulty in breathing, shortness of breath, nausea and vomiting, dizziness, weakness, convulsions, and death occurring shortly after exposure.

(b) Reported signs and symptoms suggesting a riot control or irritant agent include marked irritation or burning of the eyes with tearing and pain; irritation and burning of the nose and throat; coughing, burning and tightness in the chest; headache; and nausea and vomiting in a few cases.

(c) Reported signs and symptoms not related to any known single agent include a mixture of the above plus the features of profuse bleeding from mucous membranes of the nose, lungs, and gastrointestinal tract

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with rapid death of the affected individuals in some instances. Many of these effects were similar to those described in attacks during the war in Yemen.*

Estimates from the H'Mong interviewed indicate that approximately 700-1,000 persons may have died as a result of the use of chemical agents, and that many times this number were made ill. It was reported that on numerous occasions entire villages were devastated by these agents leaving no survivors.

In the episodes described most of the animals exposed to the chemical agents were killed. Generally, all chickens, dogs, and pigs died, and to a lesser extent, the cattle and buffalo.

On several occasions it was reported that where these agents settled on tree and plant leaves, many small holes appeared in the leaves within two or three days. Rarely did agent exposure result in the defoliation or death of the plants.

CONCLUSIONS:

The conclusions of the team based upon interviews obtained from H'Mong refugees are as follows:

1. Chemical agents have been used against the H'Mong.

2. The reported effects of these agents suggest the use of a nerve agent, a riot control agent, and an unidentified combination or compound.

* SIPRI The Problem of Chemical and Biological Warfare, Volume 5, The Prevention of CBW, page 255, Humanities Press, Inc., 300 Park Avenue South, New York, N.Y. 10010

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Table C-1

REPORTS OF PROBABLE CHEMICAL AGENT ATTACKS

DATE	LOCATION	METHOD OF ATTACK	MATERIAL USED (SMOKE OR GAS)
Jun 76	Pou Mat Sao	Plane, rockets	Red and green
Jan 77-Oct 78	Pha Khao	Plane, rockets	Yellow, red, green
Mar 77	Nam Theuna	Plane, rockets	Red and yellow
Apr 77	Houi Kam Lang	Plane, rockets	Yellow
May 77	Pha Khae	Plane, rockets	Red
May 77	Nam Moh	Plane, rockets	Yellow
May 77	Pha Ngune	Bi-plane spraying	Yellow gas
		Plane, rockets	Yellow
1977-78 x 3	Phu Seu	Plane, rockets	Red, green, yellow
Jan 78	Houi Xang	Plane, rockets	Red and green
Feb 78	Sane Mak Ku	Plane, rockets	Yellow
Feb 78	Tham Se Sam Lein	Plane, rockets	Yellow and black
Feb 78	Kio Ma Nang	Plane, rockets	Yellow
Mar 78	Mouong Ao	Plane, rockets	White
Mar 78	Khieu Manang	Plane, rockets	Green
Apr 78	Tha Se	Plane, rockets	Yellow
Jun 78	Pha Phay	Plane, rockets	Yellow
Jun 78	Phou Seng	Plane, rockets	Red, white, black
Jul 78	Phou Bia	Plane, rockets	Red
Jul 78	Ban Nam Mo	Plane - spray	Yellow
Jul 78	Phou Lap	Plane - rockets	Yellow
Aug 78	Pha Houai	Plane - rockets	Red and green
Aug 78	Ban Thin On	Plane - rockets	Green and red
Aug 78	Bouam Long	Plane - rockets	Red, green, yellow
Sep 78	Pha Koug	Plane - rockets	Yellow
Sep 78	Ban Nam Tia	Plane - spray/ rockets	Yellow, green, red
Sep 78	Pha Na Khum	Plane - rockets	Red
Oct 78	Phou Bia	Plane - rockets	
Oct 78	Ban Done	Plane - spray	Yellow
Oct 78	Phou Bia	Plane - rockets	White, green, red
Nov 78	Phou Chia	Plane - rockets	White, red
Feb 79	Pha Mat	Plane - spray	Yellow
Feb 79	Tong Moei	Plane - rockets	Yellow and red
Mar 79	Pha Mai	Plane - spray	Yellow
Apr-May 79 x 4	Pha Mai	Plane - spray	Gray-white
Mar-May 79 x 6	Pha Mai	Plane - spray	Yellow
May 79	Phou Chia	Plane - spray	Yellow
May 79	Moung Phong	Plane - rockets	Red

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Table C-1 (continued)

Department of State Interviews

DATE	LOCATION	METHOD OF ATTACK	MATERIAL USED (SMOKE/GAS)
Oct 77	Phu Hay, S of Phu Bia	Plane (L-19) rockets	Yellow-grey gas
Unk 78	Pa Sieng, S of Phu Bia	Plane unk bomb	Yellow cloud
Feb 78	Ban Nam Luk, S of Phu Bia	Planes (L-19) spray (?)	Yellow/white gas
Feb 78	20 Kms SE of Phu Bia	Plane unk spray (?)	Yellow, provided sample
Feb 78	Ban Ko Mai	Plane unk bomb	Yellow
Mar 78	Pha Houei	Plane (MIG?) sacks, burst in air	Brown gas
Mar 78	Ban Na Pong	Plane (jet?) not described	Yellow
Apr 78	Ban Phamsi	Plane not described	White, green, blood colored
May-Apr 78	Ban Nong Po	Plane (MIG?) cloud	Yellow-brown like rain
Jun 78	Ban Nam Teng	Plane unk rocket(?)	Yellow gas
Jun 78-May 79	Ban Don area	Plane (jet?) spray	Yellow rain
Mid-78	1-3 kms NE of Phu Bia	Plane unk rocket burst in air	Red gas
Oct 78	Nam Kham	Plane (L-19) rockets, air burst	Yellow cloud
Oct 78	6 kms N of Phou Khao	Plane (L-19?) rockets, air burst	Red cloud
Oct 78	3-4 kms N of Phu Bia	Plane (L-19?) rockets, air burst	Yellow gray fog
Nov 78	Phou Xang Noi	Plane (MIG?) spray	Yellow and blue cloud
Nov 78	nr Phu Bia	Plane unk bomb, air burst	Yellow substance
Nov 78	NE of Pha Khao	Plane (L-19) rocket, air burst	Yellow gas
Apr 79	Ban Nouia Pong	Plane (MIG?) spray	Yellow clouds
May 79	Nam Po	Plane (jet?) spray	Yellow substance
May 79	Pha Mai	Plane (MIG?) spray, air burst	Yellow substance

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ANNEX D

ANALYSIS AND REVIEW OF TRICHOTHECENE TOXINS

I. SAMPLE ANALYSES FOR TRICHOTHECENES

The Trichothecene Hypothesis

Since 1976, remarkably consistent reports detailing chemical attacks in Southeast Asia have been received by the Intelligence Community. Some of these reports were of particular interest in that they described the use of lethal agents producing symptoms that could not be correlated with those produced by traditionally recognized chemical warfare agents or combinations of them. Table D-1 is a compilation relating the signs and symptoms reported in Laos, Kampuchea, and Afghanistan with symptoms associated with certain chemical agents. The frequency with which a particular symptom was reported is expressed as a percentage of the total number of attacks. It is readily apparent that the symptoms most frequently described in Laos and Kampuchea correspond most closely with those produced by a group of mycotoxins, the trichothecenes. A review of the scientific literature revealed not only that these compounds had physical and chemical properties indicating potential as chemical agents, but also that they were the subjects of intensive investigation by Soviet scientists at institutes previously linked with chemical and biological warfare research. In the fall of 1980, the trichothecenes were added to the list of agents suspected to have been used in Southeast Asia and Afghanistan. Other candidates under consideration included phosgene oxime, arsines, cyanogen, nerve agents, riot control agents, and combinations of these agents.

Numerous samples from chemical attacks in Laos and Kampuchea were examined at the Chemical Systems Laboratory (CSL) for the presence of traditional chemical warfare agents and were reported to be negative. In March 1981 CSL reported the presence of an unusual compound ($C_{15}H_{24}$) in the vapor analyses from several clothing and tissue samples taken from the victim of a chemical attack. The compound was very closely related in structure to the simple trichothecenes and this finding sparked the request for analysis of all future samples for the presence of trichothecene mycotoxins.

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Table D-1

Symptoms of Chemical Attacks Reported in Laos, Kampuchea, and Afghanistan

Symptom	Percentage of Reports Mentioning Symptom	Trichothecenes	Nerve Agents	Arsines	Phosgene Oxime	Cyanogens	Incapitant (BZ)	Riot Control Agents
Laos								
Multiple deaths	84.6	X	X	X	--	X	--	--
Vomiting	71.4	X	X	X	--	--	--	X
Diarrhea	53.1	X	X	X	--	--	--	--
Hemorrhage	52.0	X	--	--	X[a]	--	--	--
Breathing difficulty	47.95	X	X	X	X	X	X	X
Itching and skin irritation	43.9	X	--	X	X	--	--	X
Nausea	42.8	X	X	X	--	--	X	X
Animal death	41.8	X	X	X	--	X	--	--
Blurred vision	39.7	X	X	X	X	X	X	X
Headache	36.7	X	X	--	X	--	X	X
Fatigue	35.7	X	X	--	--	--	X	--
Nasal excretion	34.7	X	X	X	X	--	--	X
Rash or blisters	32.6	X	--	X	X	--	--	X
Tearing	30.6	X	X	X	X	X	--	X
Coughing	28.6	X	X	X	X	X	--	X
Effect on Vegetation	26.5	X	--	?	X	--	--	--
Dizziness and vertigo	25.5	X	X	--	--	X	X	X
Facial edema	20.4	X	--	X	X	--	--	X
Thirst and dry mouth	20.4	X	--	--	--	--	X	--
Skin color change	16.3	X	--	--	X	--	--	--
Tachycardia	12.3	X	X	--	X	X	X	X
Temporary blindness	9.18	X	--	X	X	--	X	X
Rapid loss of consciousness	9.18	X[b]	X	--	--	X	X	--
Salivation	6.12	X[c]	X	--	--	--	--	--
Hearing loss	5.1	X	--	--	--	--	--	--
Tremors or convulsions	4	X	X	--	X	X	--	--
Sweating	3	--	X	--	--	--	--	--
Paralysis	3	X	X	--	--	X	--	--
Loss of appetite	3	X	X	X	--	--	--	--
Frequent urination	2	X	X	--	--	--	--	--

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Table D-1 (continued)

Symptom	Percentage of Reports Mentioning Symptom	Trichothecenes	Nerve Agents	Arsines	Phosgene Oxime	Cyanogens	Incapitant (BZ)	Riot Control Agents
Kampuchea								
Multiple deaths	72.4	X	X	X	--	X	--	--
Hemorrhage	62.06	X	--	--	X[d]	--	--	--
Dizziness and vertigo	51.7	X	X	--	--	X	X	X
Vomiting	41.3	X	X	X	--	--	--	X
Nausea	34.5	X	X	X	--	--	X	X
Skin irritation	27.6	X	--	X	X	--	--	X
Rapid loss of consciousness	24.1	X[b]	X	--	--	X	X	--
Fever	20.68	X	--	--	--	--	--	--
Headache	17.2	X	X	--	X	--	X	X
Tearing	13.8	X	X	X	X	X	X	X
Breathing difficulty	13.8	X	X	X	X	X	X	X
Fatigue	13.8	X	X	--	--	--	X	--
Paralysis	10.3	X	X	--	--	X	--	--
Numbness	6.9	X	X	--	--	X	X	?
Blurred vision	6.9	X	X	X	X	X	X	X
Dry throat and thirst	6.9	X	--	--	--	--	X	--
Edema	6.9	X	--	X	X	--	--	--
Salivation	3.4	X[e]	X	--	--	--	--	--
Vegetation affected	3.4	X	--	?	?	--	--	--
Diarrhea	3.4	X	X	X	--	--	--	--
Cough	3.4	X	--	X	X	X	X	X
Nasal discharge	3.4	X	X	X	X	--	--	X
Rash or blister	3.4	X	--	X	X	--	--	X
Chills	3.4	X	?	--	--	--	--	--
Hearing loss	3.4	X	--	--	--	--	--	--

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Table D-1 (continued)

Symptom	Percentage of Reports Mentioning Symptom	Trichothecenes	Nerve Agents	Arsines	Phosgene Oxime	Cyanogens	Incapitant (BZ)	Riot Control Agents
Afghanistan								
Rapid loss of consciousness	47.9	X[b]	X	--	--	X	X	--
Skin irritation and itching	31.5	X	--	X	X	--	--	X
Multiple deaths	30.1	X	X	X	--	X	--	--
Nausea	20.5	X	X	X	--	--	X	X
Vomiting	19.1	X	X	X	--	--	--	X
Tearing	17.8	X	X	X	X	X	--	X
Dizziness and vertigo	16.4	X	X	--	--	X	X	X
Blisters or rash	15	X	--	X	X	--	--	X
Difficulty breathing	13.7	X	X	X	X	X	X	X
Paralysis	13.7	X	X	--	--	X	--	--
Headache	12.3	X	X	--	X	--	X	X
Temporary blindness	8.2	X	--	X	X	--	X	X
Salivation	6.8	X[c]	X	--	--	--	--	--
Loss of appetite	6.8	X	X	X	--	--	--	--
Effects on vegetation	5.5	X	--	--	--	--	--	--
Fatigue	5	X	X	--	--	--	X	--
Confusion	4.1	--	X	--	--	--	X	--
Hemorrhage	4.1	X	--	--	X[a]	--	--	--
Change in skin color	2.8	X	--	--	X	--	--	--
Diarrhea	2.8	X	X	X	--	--	--	--
Coughing	1.3	X	X	X	X	X	X	X

[a] Bloody frothing.
[b] Only at very high doses.
[c] Depending on which trichothecenes.
[d] Blood flecked frothing.
[e] Depending on compound.

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The Kampuchean Leaf and Stem Sample--The First Analysis for Trichothecenes

On 24 March 1981 a number of samples from the US Embassy in Bangkok was received. Two of the samples were reported to have been collected from the site of a chemical attack that occurred in the vicinity of TV 3391, an area just south of Phnum Mak Hoeun. A vegetation sample and a water sample were collected within 24 hours of the attack. Examination of bodies of victims of this attack by medical personnel revealed highly unusual degeneration of the mucosal lining of the gastrointestinal tract. The effects described paralleled those known to be produced by the trichothecenes. The samples were submitted to Chemical Systems Laboratory for analysis for the presence of chemical warfare agents. No evidence of known chemical warfare agents was found. An initial test for the trichothecenes by thin layer chromatography (TLC) was inconclusive because of severe problems with interfering substances and the lack of appropriate standards. The trichothecenes are difficult to detect even under ideal circumstances and the presence of interfering substances in the sample may make identification and quantitation by TLC inconclusive. A review of the limitations and potentials of analytic methods for trichothecenes led those authors to conclude that the computerized gas chromatography/mass spectroscopy method in the selected ion monitoring mode would enable precise identification and quantitation of these compounds in complex mixtures. An additional recent publication includes a summary of the currently available methods suitable for trichothecene analysis and an assessment of their utility and limitations.

A portion of the leaf and stem sample was furnished to the US Army for further analysis. This sample (see table D-2, group I/A), a positive control sample to which T-2 toxin was added (group I/B), and a negative control sample of similar vegetation (group I/C) were forwarded to Dr. Chester J. Mirocha, Department of Plant Pathology, University of Minnesota. Dr. Mirocha was given no information concerning the history or content of the samples, and was requested to analyze the three unknowns for the presence of trichothecene toxins using the best methods at his disposal. Briefly, the analysis involves a series of extractions followed by ferric gel separation, selected ion monitoring on a computerized gas chromatograph/mass spectrometer, and a full mass spectral scan for comparison with known stand-

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Table D-2

Trichothecene Sample Analyses

Reference Number/ CASE Number	Code	Date Received	Description	Current Status
Sample Group I/ M-22-81		29 Apr 81	Leaf and stem + negative control	Analysis complete.
	A		Sample from attack area	Code A sample: T-2 - 3.15 ppm Nivalenol - 109 ppm Deoxynivalenol - 59.1 ppm
	B		(spiked) pos. control	Code B sample: T-2 - 35.7 ppm Nivalenol - 21.7 ppm
	C		External neg. control	Code C sample: Negative results
Sample Group II/ M-23-81		26 Aug 81	Environmental samples	Analysis complete.
	D		Water	Code D sample: Deoxynivalenol - 66 ppm Diacetoxyscirpenol - Trace
	E[a]		Yellow powder	Code E sample: T-2 - 150 ppm Diacetoxyscirpenol - approx. 25 ppm
	F		Speck (unknown substance)	Code F sample: Diacetoxyscirpenol - 10 ng

[a] Additional 25 mg of this sample was provided to laboratory for analysis for nivalenol and deoxynivalenol (see Sample Group X/M-11-82)

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Table D-2 (continued)

Trichothecene Sample Analyses

Reference Number/ CASE Number	Code	Date Received	Description	Current Status
Sample Group III/ M-26-81		20 Sep 81	Environmental samples (Negative controls)	Analysis complete.
	A		Water sample	Negative results on all samples tested to date.
	B		Soil sample	
	C		Soil sample	
	D		Dried corn	
	E		Rice	
	F		Leaves and stem	
	G		Leaves and stem	
	H		Leaves and stem	
	I		Leaves and stem	
Sample Group IV/ M-1-82		5 Oct 81	Environmental samples (Negative controls)	Retained at USAMIIA pending results of higher priority analyses.
Sample Group V/ M-2-82		11 Oct 81	Blood samples	Analysis complete.
	A14			Negative results on all samples tested to date.
	A15			
	A16			
	A17			
Sample Group VI/ M-3-82		22 Oct 81	Blood samples	Analysis complete. Analytical findings to date have tentatively identified HT-2, a deacetylated metabolite of T-2 toxin, in the blood of patients 3 and 4 (see Table D-3).

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Table D-2 (continued)

Trichothecene Sample Analyses

Reference Number/ CASE Number	Code	Date Received	Description	Current Status
	A1 . . . A13 B1 . . . . B-13			Medical laboratory evaluation of blood samples conducted by US Army Medical Research Institute of Infectious Diseases (USAMRIID). No significant statistical differences between control samples from alleged victims of ''yellow rain, but a trend toward low blood cell counts in victims was noted. See Table D-3
Sample Group VII/ M-7-82		17 Nov 81	Blood samples	Retained at USAMIIA pending completion of higher priority analyses. A metabolite of T2 toxin (HT_2) was tentatively identified in the blood of two victims of a CW attack.
Sample Group VIII/ M-8-82		17 Nov 81	Environmental samples	Analysis in progress.
Sample Group IX/ M-9-82		6 Nov 81	Environmental samples (Sock, pants, mask, water)	Analysis in progress.
Sample Group X/ M-11-82		19 Nov 81	Environmental sample	Analysis complete. 143 ppm T_2 27 ppm DAS 0 Nivalenol 0 Deoxynivalenol
	E-2		Yellow powder	

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ards. The methods used are among the most sensitive and specific for detection of these compounds; also false positives are rare. Toxins can be identified by their mass spectra and quantified with a high degree of accuracy. Group I/A--the vegetation sample allegedly exposed to a CW agent--was found to contain 109 parts per million (ppm) of nivalenol, 59.1 ppm of deoxynivalenol, and 3.15 ppm of T-2 toxin; each is a potent toxin of the trichothecene group. No trichothecenes were detected in the negative control sample (group I/C), and 35 ppm of T-2 toxin were detected in group I/B--the sample to which T-2 toxin had been added. It was Dr. Mirocha's assessment that a mixture of these particular toxins in the high levels detected could not have occurred as a result of natural contamination.

The possibility that the identified toxins were produced by natural fungal contamination is addressed in section III. In summary, the possibility was discounted on the basis of the climatic conditions required for production of T-2 toxin, the high levels of toxins detected, the unusual mixture of toxins found, and the results of surveys of Southeast Asia for the presence of these toxins. This conclusion was supported by the analysis of normal flora samples from Kampuchea described below.

Analyses of Control Samples From Kampuchea for the Presence of Trichothecenes

On 20 September 1981, nine control samples were received from US Army personnel in Bangkok, Thailand, for the purpose of conducting laboratory analyses for background levels of trichothecene toxins. The samples were collected from an area near TV 3391 that had not been subjected to any reported chemical attacks. The samples were collected by US personnel under instructions to reproduce the sampling conditions, handling, packaging, and transfer conditions of the original sample as closely as possible. The same species of plant was sampled, and three other vegetation samples were also collected. A water sample as well as two soil samples were recovered. Samples of corn and rice from the area were also taken. These grains provide an ideal substrate for growth of toxin-producing fungi and would therefore be a sensitive indicator of any natural occurrence. The nine samples were forwarded under code to Dr. Mirocha for trichothecene analysis. A portion of each sample was also submitted to CSL for background determinations of CN-, Cl-, and Fl- levels. No trichothecenes were detected in any of these samples (group III/A-I), indicating that nivalenol,

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deoxynivalenol, T-2, and diacetoxyscirpenol are not prevalent in the geographical area from which the alleged CW exposed sample was collected. The appearance of these trichothecenes in high levels and unique combinations in a sample associated with a chemical attack producing symptoms typical of trichothecenes exposure indicates that these toxins may have been used as chemical weapons. This conclusion is further supposed by the confirmatory evidence provided by the analysis of additional alleged CW samples from Laos and Kampuchea which are described below.

Analysis of Additional CW Samples From Laos and Kampuchea for the Presence of Trichothecenes

Chemical Systems Laboratory provided three additional suspected chemical warfare samples for analysis for trichothecenes. The first sample (group II/D) consisted of 10 ml of water taken from the same chemical attack site in Kampuchea as the leaf and stem sample previously examined (group I/A). The second sample (group II/E) came from the site of a ''yellow rain'' attack occurring on 13 March 1981 in the village of Muong Cha (TF 9797) in the Phou Bia region of Laos. The agent was sprayed from a twin-engine propeller aircraft at approximately 1200 hours. The falling substance was described as ''like insect spray'' and sounded like drizzling rain. It was quite sticky at first, but soon dried to a powder. Symptoms described by victims included nausea, vomiting, and diarrhea. A sample of the agent scraped from the surface of a rock by a victim and carried into Thailand was turned over to US Embassy personnel. The third sample (group II/F) was taken from the site of a ''yellow rain'' attack that occurred at 1400 hours on 2 April 1981 at Ban Thong Hak (TF 9177). Twenty-four people reportedly died in this attack and there were 47 survivors. Symptoms included severe skin irritation and rash, nausea, vomiting, and bloody diarrhea. This sample was scraped from the surface of a rock with a bamboo knife by a survivor of the attack. Although the individual took precautions (that is, cloth mask) a severe skin rash and blisters developed.

These three samples were submitted to Dr. Mirocha for analysis. Group II/D (the water sample from Kampuchea) contained 66 ppm of deoxynivalenol and a trace amount of diacetoxyscirpenol (DAS). A trace quantity of group II/E was screened as strong positive for trichothecenes. Further analysis of that sample confirmed the presence of high levels of T-2 toxin (150 ppm) and diacetoxyscirpenol (25 ppm).

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Interference from phtalate compounds (leached from the plastic packaging) made detection of nivalenol and deoxynivalenol difficult. In a second analysis, the extraction process was modified so that nivalenol and deoxynivalenol could be measured accurately. The analysis showed the presence of 143 ppm T_2 and 27 ppm DAS. No nivalenol or deoxynivalenol was detected. Interestingly, examination of the petroleum ether fraction from sample group II/E revealed the presence of a yellow pigment almost identical to that previously identified by Dr. Mirocha in cultures of Fusarium roseum, indicating that the yellow powder probably consisted of the crude extract of a Fusarium culture.

There was very little of group II/F contained in the vial received for testing. The quantity was too small to be accurately weighed and inspection of the vial revealed only a very small speck estimated to weigh much less than 0.1 mg. That speck contained 10 ng of diacteoxyscirpenol, a level equivalent to 100 ppm at the very least and probably much higher. The sample size was too small to allow adequate analysis for the other three trichothecenes of interest.

These results, in general, support the hypothesis that trichothecenes have been used as chemical warfare agents in Laos and Kampuchea. The presence of these high levels of trichothecene toxins in water and in yellow powder scraped from rocks argue against natural occurrence, since neither water nor rock is a suitable environment for growth of the fungi required to produce the toxins.

Differences between the analyses of the Kampuchean leaf and stem sample and the water sample collected from the same attack site raise additional questions. The failure to find T-2 toxin in the water sample is probably due to the relative insolubility of T-2 toxin in water. The presence of DAS in the water might be the result of biotransformation or breakdown of T-2, as they are so structurally similar, differing only in the substitution on carbon 8. While this hypothesis cannot be entirely ruled out it is unlikely on the basis of known biotransformation of T-2 in the laboratory. The initial vegetation sample was not screened for DAS, though the mass spectra from the initial analysis will be reexamined for trace amounts of DAS.

The absence of nivalenol in the water sample is more difficult to explain because nivalenol is water soluble. The effect of environmental conditions and microorganisms on the stability of these compounds may vary widely for each of the specific compounds and may explain the analytical results. Further scientific investigation of these factors is needed.

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II. ANALYSIS OF BLOOD SAMPLES FROM CHEMICAL ATTACK VICTIMS

Blood samples drawn from victims of recent chemical attacks have been received for analysis for indications of trichothecene exposure. Little is known concerning the rate of metabolism of trichothecenes in humans; it is difficult, therefore, to estimate the probability of detection of trichothecenes or their metabolites in blood samples. T-2 is rapidly cleared from the blood in animals, and 25 percent of the total dose is excreted within 24 hours after exposure; therefore, it is unlikely that trichothecenes could be detected unless samples were obtained within 24 to 48 hours after an attack. Other blood parameters are affected by the trichothecenes, however, and may prove to be useful markers. The trichothecenes induce a severe leukopenia (decrease in white cell count) which can persist for several weeks following exposure. In addition, the trichothecenes affect some liver and kidney function marker enzymes which can be monitored in the blood.

On 11 October 1981, four whole blood samples and four blood smears were received from the US Embassy, Bangkok. The blood was drawn from four Khmer Rouge soldiers on 7 October inside Kampuchea. Detailed medical histories as well as descriptions of the attack were recorded on each individual from whom a blood sample was taken. All four men were victims of a gas attack occurring in the fall of 1981 near Takong. Symptoms experienced included vomiting, blurred vision, bloody diarrhea, difficulty breathing, dry throat, loss of consciousness, frontal headache, tachycardia, and facial edema. Unfortunately, the samples could not be refrigerated until 48 hours after collection. It was therefore not possible to obtain data concerning white cell counts and blood chemistry. The four whole blood samples were submitted to Dr. Mirocha for analysis for trichothecene metabolites because of the possibility (admittedly remote) that some of the metabolites may bind to blood proteins and may still be detectable even three weeks after an attack. These analyses are reported as group V A14-A17 in table D-2.

On 22 October 1981 additional blood samples were received. These had been drawn from nine victims from the 19 September attack and from four control individuals of similar age and background who had not been exposed to a chemical attack. The samples had been properly refrigerated and were accompanied by very complete and detailed medical histories taken by trained medical personnel who examined the individuals. Included in the package were blood smears and heparinized and nonheparinized samples from each individual. The samples were

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submitted to US Army Medical Research Institute of Infectious Diseases (USAMRIID) for blood assays. These results are reported in table D-3.

The above results show no statistically significant differences between exposed and control groups (students T-test). A trend toward depressed white cell counts in eight individuals exposed to chemical agent was observed. Such an observation would be compatible with the clinical picture of toxin exposure; however, it is also compatible with a number of other medical problems and a larger control sample would be required before such results could be adequately interpreted. Abnormal liver and kidney functions were not indicated by this data.

Portions of these blood samples were analyzed by Dr. Mirocha for presence of trichothecenes and/or trichothecene metabolites. The results of those analyses are consistent with trichothecene exposure in at least two of the gassing victims and tend to support the hypothesis that a trichothecene-based agent was used in this attack.

Using the selected ion-monitoring gas chromatography/mass spectroscopy analysis technique, Dr. Mirocha was able to identify tentatively a metabolite of T_2 toxin (that is, HT_2) in the blood of two alleged victims. The compound was identified on the basis of its selected ion masses and gas chromatographic retention times.

The tentative identification of HT_2 in the blood of two victims, and the trend toward depressed white cell counts in these same victims, cannot be taken as conclusive scientific proof of toxin exposure because the trace amount of the compound present precluded unequivocal identification and quantitation, and also because many other medical problems in addition to toxin exposure can cause a decrease in white cell counts. It is interesting to note that the individual who showed the greatest amount of the compound tentatively identified as HT_2 in his blood, was reported to have received the greatest exposure to the agent and also had the lowest WBC. He was exposed to contaminated water for more than 30 minutes and was the only victim who fell down in the water and actually swallowed some of it. However, the description by victims of symptoms correlating exactly with those associated with trichothecene poisoning, provide strong circumstantial evidence that trichothecenes were used as chemical agents in yet another chemical attack in Southeast Asia.

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Table D-3

Peripheral Blood Hemograms of
Kampuchean Victims of Chemical Attack

Patient No.	RBC[a]	Hgb[b]	Hct[c]	WBC[d]	Retic[e]	MCV[f]	MCH[g]	MCHC[h]
1	specimen clotted							
2	4.46	12.6	37	4,700	1.0	84	28.5	34
3	4.90	11.8	40	5,700	0.4	81	26	32
4	4.90	10.3	34	1,700	2.1	70	21	30
5	4.92	15.0	46	5,300	1.2	93	32	34
6	4.04	12.6	37	4,300	0.8	93	31	34
7	4.88	15.6	46	3,000	0.5	94	32	34
8	5.56	17.0	50	8,700	1.5	91	31	34
9	4.88	11.2	35	5,000	1.0	73	23	32
Controls:								
10	6.23	12.5	41	7,200	0.8	66	20	30
11	4.47	11.9	38	8,000	0.9	85	26.5	31
12	4.88	12.9	41	5,100	2.0	85	26.5	32
13	5.16	15.6	46	6,500	1.0	90	30.5	34
Normal range: male	4.5-6.0	14-18	40-54	7,400		80-94	27-32	33-38
female	3.5-5.0	12-16	37-47	±2,000				

		BUN[i]	Creatinine	SGPT[j]	Alkaline Phosphatase
Normal Range	M	7-20	0.4-1.7	6-37	24-69
	F				23-71
	1.	9.0	3.5	48	132
	2.	8.5	0.8	36	47
	3.	8.0	1.4	12	75

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Table D-3 (continued)

Peripheral Blood Hemograms of
Kampuchean Victims of Chemical Attack

	BUN[i]	Creatinine	SGPT[j]	Alkaline Phosphatase
4A.	11	1.3	6	94
4B.	10.5	1.2	6	68
5.	6.0	1.6	12	84
6.	7	1.2	18	115
7.	8.5	1.7	6	69
8.	10	1.5	36	79
9.	12.5	1.4	12	70
10.	10.5	1.8	12	86
11.	12	0.8	24	74
12.	12	1.4	6	76
13.	9.0	1.2	30	102

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a Red blood cells $x10^{-6}$ (#/cc)
b Hemoglobin (gm/100cc)
c Hematocrit (%)
d White blood cells (#/cc)
e Reticulocytes (#/cc)
f Mean corpuscular volume (u^3)
g Mean corpuscular hemoglobin (uug)
h Mean corpuscular hemoglobin concentration (%)
i Blood urea nitrogen (mg%)
j Serum glutamic pyruoic transaminase

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Trichothecenes have been identified previously in environmental samples taken from several other chemical attacks in Laos and Kampuchea. Analysis of control vegetation, water, soil, corn, and rice samples from these areas, as well as reviews of published scientific literature, indicate that the particular toxins that have previously been identified are not known to occur naturally in the combinations found and at the levels detected in Southeast Asia. The latest analysis results contribute another piece of evidence to the growing body of data supporting the charge that trichothecenes have been used as chemical/biological agents in Southeast Asia.

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III. OVERVIEW OF NATURAL OCCURRENCE AND SIGNIFICANT PROPERTIES OF TRICHOTHECENES

Historical Trichothecene Mycotoxicoses

The trichothecenes are members of a large group of naturally occurring toxins known as mycotoxins. The word ''mycotoxin'' is derived from the Greek ''mykes'' meaning fungus and the Latin ''toxicum'' meaning poison. It refers to a metabolite produced by a mold that is toxic to man or animals. Mycotoxicoses have been described as the ''neglected diseases'' and, before 1960, little English-language literature concerning the diseases caused by mycotoxins was available. Interestingly, the first comprehensive studies of mycotoxin diseases were conducted in the Soviet Union in the late 1930s. Thus, Soviet scientists have been involved in research with some of these compounds for almost 30 years longer than their Western counterparts (see section V of this annex). The Soviet Union has had serious problems with mycotoxin contamination of food and has suffered several severe outbreaks of disease in humans.

The group of mycotoxins that has figured most prominently in Soviet scientific literature since the 1940s are the trichothecenes. They are a group of chemically related, biologically active fungal metabolites produced primarily by various species of Fusarium. Table D-4 lists some of the toxins in this group and producing fungi. The fungi are well-known plant pathogens that frequently invade numerous agricultural products.

Trichothecene toxins, perhaps more than any other mycotoxins, have been associated with acute disease in humans. Most of the human intoxications occurred in the Soviet Union (table D-5). The earliest recognized outbreak occurred in 1891 in the Ussuri district of eastern Siberia. Humans who consumed contaminated grain exhibited headache, chills, nausea, vomiting, vertigo, and visual disturbances. Dogs, horses, pigs, and domestic fowls were reported to be affected.

The most extensive mycotoxicosis outbreak reported to have caused multiple fatalities in man also occurred in the Soviet Union. In 1944 30 percent of the population of Orenburg near Siberia was affected by alimentary toxic aleukia or ATA, a disease later shown to be due to ingestion of trichothecene toxins. Over 10 percent of the entire population of the Orenburg district died of the disease. Numerous other

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TABLE D-4

Trichothecene-Producing Fungi

Type	(A) T-2 Type	(B) Nivalenol-Type	(C) Macrocylic
Trichothecenes	T_2 Toxin	Nivalenol	Roridins
	HT_2 Toxin	Monoavetyl-Nivalenol	Veirucarins
	Diacetoxy-Scirpenol	Diacetgl-Nivalenol	Satratoxins
	Neosolaniol	Deoxynivalenol	Vertisporin
Fungus	F. tricinctum	F. nivale	Myrothecium verrucaria
	F. roseum	F. opisphaeria	
			M. roridum
	F. equiseti	F. roseum	
	F. sporotrichioides		Stachybotrys atra
	F. lateritium		Verticimonosporium diffractum
	F. poae		
	F. solani		
	F. rigidiusculum		
	F. semitectum		

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TABLE D-5

Historical Trichothecene Mycotoxicosis

Toxicosis	Districts and Affected Species	Symptoms
''Taumelgetreide'' Toxicosis	USSR Man, farm animals	Headache, nausea, vomiting, vertigo, chills, visual disturbances
Alimentary toxic aleukia	USSR Man, horse, pig	Vomiting, diarrhea, multiple hemorrhage, skin inflamation, leukopenia, angina
Stachibotryotoxicosis	USSR, Europe Horse	Shock, somatitis, hemorrhage, dermal necrosis, nervous disorders
Bean-hull toxicosis	Japan Horse	Convulsion, cyclic movement
Dendrodochiotoxicosis	USSR, Europe Horse	Skin inflamation, hemorrhage
Moldy corn toxicosis	United States Pig, cow	Emesis, hemorrhage
Red mold toxicosis	Japan, USSR Man, horse, pig, cow	Vomiting, diarrhea congestion and hemorrhage of lung and intestine

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outbreaks of ATA occurred in the Soviet Union, primarily between the years 1942-1947. The contamination was traced to overwintered millet, wheat, and barley infected with Fusarium. Symptoms of the disease included vomiting, skin inflammation, multiple hemorrhaging (especially of the lung and gastrointestinal tissue), diarrhea, leukopenia, and suppression of bone marrow activity.

In 1939, Nikita Khrushchev was dispatched to the Ukraine region of Russia by Premier Joseph Stalin to organize and improve agricultural operations and to identify the disease that was causing the deaths of many horses and cattle. The problem was traced to hay and straw contaminated with Stachybotrys atra. The disease, later referred to as stachybotryotoxicosis, occurred after ingestion or contact with the contaminated grain. Symptoms included ulcerative dermatitis, perioral dermatitis, blood dyscrasias, hemorrhagic syndromes, abortion, and death. The greatest economic impact was due to loss of horses, but cattle, sheep, poultry, and humans were also affected.

Other disease outbreaks in which similar symptoms were exhibited occurred in 1958 and 1959 among horses and cattle in the Soviet Union and Eastern Europe. Thousands of animals were lost in these outbreaks. Other intoxications were reported subsequently in Japan, Europe, the Soviet Union, and the United States, affecting various domestic animals and--in the case of red mold toxicosis--affecting man. All of these diseases have now been shown to be due to ingestion of trichothecenes rather than to an infectious agent. In earlier disease outbreaks, the levels of toxin present in the contaminated grain was not measured; however, the levels of nivalenol and/or deoxynivalenol measured in toxic grains implicated in more recent outbreaks (that is, ''moldy corn toxicosis'' and ''red mold toxicosis'') were typically between 2 and 8 ppm.

Natural Occurrence of Trichothecene Mycotoxins

Publications concerning the occurrence of trichothecenes have been relatively scarce because of the lack of convenient detection methods and the complexity of the trichothecene family of compounds. Only recently have scientists developed methods capable of distinguishing between close structural derivatives and accurately quantitating the levels of toxin present (see table D-6 for comparison of analytical methods). Extreme care must be taken when reviewing the scientific

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TABLE D-6

Physiochemical Methods for Detection of Trichothecenes in Feedstuffs

Method	Trichothescenes Detected	Detection Limits	Required Standards	Use and Limitation
Thin-layer chromatography 1-dimension	All	0.1 micogram/spot (H_2SO_4)	Reference Standard	Qualitative Interference Not confirmatory
Thin-layer chromatography 2-dimension	All	0.1-1.0 microgram/ spot (H_2SO_4)	Reference Standard	Qualitative Less interference Confirmatory
Gas-liquid chromatography	Nonhydroxy-lated or TMS derivatives	0.03-0.05 microgram/ microliter injection	Reference Standard	Quantitative Monoglyceride interference Equivocable identification
Gas chromato-graphy/mass spectrometry-normal scanning mode	TMS derivatives	0.02-0.05 microgram/ microliter injection	Reference Standard or Spectrogram	Semiquantitative Less interference Unequivocable identification
Gas chromato-graphy/mass spectrometry-selection ion monitoring	TMS derivatives	0.007-0.02 microgram/ microliter injection	Reference Standard or Spectrogram	Quantitative Best for complex mixtures Unequivocable identification
Nuclear-magnetic-resonance	All	----	Reference Standard or Spectrogram	Confirmatory Purified toxin structure elucidation

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TABLE D-6 (continued)

Method	Trichothescenes Detected	Detection Limits	Required Standards	Use and Limitation
Radioimmunoassay (developmental stage)	T-2 toxin	1-20 nanogram	Rabbit anti-T-2 toxin anti-body ^{3}H-T-2 toxin	Sensitive Low interference Relative structural specificity

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literature on natural occurrence of these compounds, because erroneous conclusions can be drawn on the basis of results obtained with inadequate analytical techniques. Misidentification of compounds and gross overestimation of concentrations have occurred using techniques such as thin layer chromatography as the basis of analysis. Table D-7 lists the reports of natural occurrence of T-2 toxin, diacetoxyscirpenol, and nivalenol that were obtained from a literature search of over 3,000 citations concerned with trichothecene toxins. Levels that are questionable on the basis of techniques used are indicates. It is immediately apparent that the levels of toxins found in the various samples from Laos and Kampuchea are highly unusual, even if one accepts the questionable reports in table D-7 as valid. The levels of these toxins (150 ppm T-2 toxin, 109 ppm of nivalenol, more than 100 ppm of diacetoxyscirpenol, and 66 ppm of deoxynivalenol) are markedly higher than those reported to occur in nature. It should also be noted that the incidences recorded in table D-7 concern levels of toxin produced when Fusarium is growing on its ideal substrate, while the Laos and Kampuchea samples were taken from surfaces that would be extremely unlikely to support Fusaria growth and toxin production, that is, the surface of rocks and water. Higher levels of toxin production can, of course, be induced when the mold species is grown in pure culture under ideal conditions in the laboratory; for instance, the Soviets have succeeded in producing 4 grams of T-2 per kilogram of substrate. In a natural environment, however, the Fusaria species cannot compete well with other molds such as species of Aspergillus and Penicillium, and, as in table D-7, levels of toxin produced are orders of magnitude lower.

The conclusion that the levels of toxins found in the Southeast Asia samples could have occurred only by means of an unnatural mechanism is also strengthened by surveys of the area conducted by various researchers. Surveys of the toxigenic fungi and mycotoxins of Southeast Asia conducted by the Mahidol University in Bangkok and the Massachusetts Institute of Technology, have not revealed the presence of T-2, nivalenol, deoxynivalenol, or diacetoxyscirpenol, although other mycotoxins such as aflatoxin, were identified. These results were confirmed by our analysis using our own methodology of normal flora samples of vegetation, soil, water, corn, and rice from Kampuchea that revealed the presence of no trichothecenes.

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Table D-7
1. Spontaneous Occurrence of Trichothecene Mycotoxins

Toxin	Country	Source	Concentration (parts per million)	Reference[a]
T-2 Toxin				
	USA	Mixed feed	0.08[b]	15
	UK	Brewer's grains	ND[c]	19
	India	Sweet corn	4[b,d]	5
	Canada	Corn	ND[d]	4
	India	Sorghum	ND[d]	22
	Canada	Barley	25[d]	20
	India	Safflower seed	3-5[d]	6
	US	Corn stalks	0.11[b]	16
	US	Feed supplement	ND	7
	US	Corn	2	8
	US	Mixed feed	0.3	14
	France	Corn	0.02[b]	10
	US	Corn	ND	2
Diacetoxyscirpenol				
	US	Mixed feed	0.5	15
	US	Mixed feed	0.38	15
	India	Safflower seed	3-5[d]	6
	India	Sweet corn	14[d]	5
	Germany	Corn	31.5[d]	23
	US	Corn	0.88	21
Deoxynivalenol				
	US	Corn stalks	1.5[b]	16
	US	Corn	1.8[b]	15
	US	Corn	1.0[b]	15
	US	Corn	0.1[b]	15
	US	Mixed feed	0.04[b]	15
	US	Mixed feed	1.0[b]	15
	US	Mixed feed	1.0[b]	15
	US	Corn	7.4	9
	US	Corn	0.1-25[d]	21
	US	Corn	trace-25[d]	2, 21

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Table D-7 (continued)

Toxin	Country	Source	Concentration (parts per million)	Reference[a]
Deoxynivalenol (Continued)				
	US	Corn	1.1-10.7	26
	US	Corn	41	25
	US	Corn	1.0[b]	17
	US	Oats	5[a]	17
	Japan	Barley	ND	18
	US	Corn	1.0[b]	13
	US	Corn	0.06[b]	13
	US	Mixed feed	0.07[b]	13
	France	Corn	0.6[b]	10
	South Africa	Corn	2.5	11
	Zambia	Corn	7.4	11
	US	Corn	ND	2
	Japan	Barley	7.3	18
	Austria	Corn	1.3	24
	Austria	Corn	7.9	24
	Canada	Corn	7.9	24
Nivalenol				
	Japan	Barley	ND	18
	France	Corn	4.3[b]	10
Partially characterized trichothecenes				
	US	Corn	ND[d]	25
	India	Safflower seed	ND	6
Skin irritant factors-not analyzed chemically				
	US	Corn	93 positive[b] of 173	3
	US	Corn	Multiple positive samples	21
	Yugoslavia	Corn	16 positive of 191	1

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[a] References:

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4. Funnel (1979)
5. Ghosal et al. (1978)
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7. Hibbs et al. (1974)
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9. Isshi et al. (1975)
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11. Marasas et al. (1977)
12. Miller (1976)
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19. Petrie et al. (1977)
20. Puls and Greenway (1976)
21. Romer, T., Ralston Purina, St. Louis, MO (personal communication)
22. Rukmini and Bhat (1978)
23. Siegfried (1979)
24. Vesonder and Ciegler (1979)
25. Vesonder et al. (1976)
26. Vesonder et al. (1978)

[b] Zearalenone (F-2 Toxin) also detected in the sample.
[c] ND = toxin concentration was not determined.
[d] Levels that are questionable on the basis of techniques used.

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Skeptics have formulated theoretical explanations for the analytical results to support a hypothesis of natural occurrence of these toxins. It was postulated that the trichothecenes found were absorbed through the roots of a plant, translocated to the leaves, and exuded and washed onto the surface of a rock and into water where they were found. A 1981 publication by Jarvis et al. reported a Brazilian shrub that appeared to absorb, translocate, and chemically alter a macrocyclic trichothecene produced by a soil fungi. While this citation is used to support a hypothetical mode for natural deposition in Southeast Asia it should be noted that the plant reported by Jarvis et al. did not exude the toxin, that the toxin was extremely phytotoxic to all other plants assessed, and that the plant was not capable of denovo trichothecene synthesis. No other trichothecenes have been found to be absorbed and translocated in any other plant in this manner. Control samples of soil and vegetation from Southeast Asia do not support endemic presence of these toxins. The appearance of these particular trichothecene toxins in these high levels in environments generally inhospitable to their formation cannot reasonably be attributed to a natural contamination.

Chemical and Physical Properties of the Trichothecenes

When considering the suitability of trichothecenes as agents, factors such as stability, solubility, and ease of production must be considered. The general structure for the trichothecene group is shown in figure D-1. There are over 40 currently known, naturally occurring, 12 to 13 epoxytrichothecenes. The R groups may be hydroxyls, acylated hydroxyl groups, or esters. The R group for the toxins detected in Sample Group I/A are shown below the general structure. All of the compounds have in common an olefinic double bond at carbon atoms 9 and 10 and an epoxy group at carbon atoms 12 and 13. These compounds are stable, especially in the solid form. They may be stored for years at room temperature with no loss of activity. They are heat stable with no loss of activity noted after heating for 1 hour at 100 degrees centigrade. The solubility depends on the R groups; highly hydroxylated derivatives are more water soluble. The compounds are also quite stable in solution. Detoxification can be accomplished by treatment with strong mineral acid, which will open the 12 to 13 epoxide bond and abolish all biological activity. Most of the toxins are well absorbed through mucous membranes and some through skin; this property is also a function of the R group.

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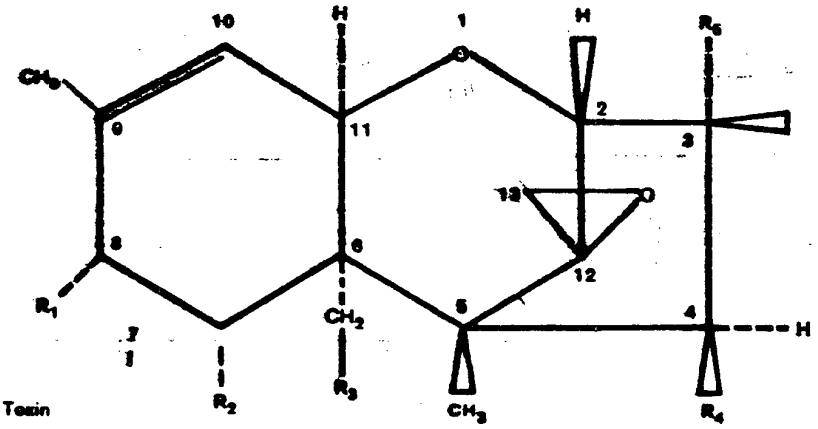
Figure D-1

General Structure of Trichothecenes



T-2 Toxin

R_1 = O—C(=O)—CH_2—CH(CH_3)(CH_3)

R_2 = H

R_3 = OAc

R_4 = OAc

R_5 = OH

	Nivalenol	Deoxynivalenol
R_1	= O	= O
R_2	= OH	= OH
R_3	= OH	= OH
R_4	= OH	= H
R_5	= H	= H

Unclassified

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Some of these compounds have been synthesized chemically; however, biosynthesis employing Fusarium species is the most effective way to produce large quantities. In a preliminary search of recent Soviet open source literature, 50 articles dealing with the trichothecenes were reviewed. Of these, 22 dealt with defining optimum conditions for biosynthesis of the compounds. N. A. Kostyunina has reported production of T-2 toxin at levels of 4 grams per kilograms of substrate (normally wheat grain, or rice). Numerous industrial microbiology plants have been identified in the Soviet Union. Some of these are involved in production of single-cell protein for fodder additives, others produce antibiotics, and the function of still others is unknown. The only difference between an antibiotic and mycotoxin is their target specificity. Both are produced by fungi, but the mycotoxins are relatively more toxic to man than to microorganisms. Mycotoxins can be produced in good yield employing the same techniques that are used to produce some antibiotics. Thus, it may be concluded that the Soviets could produce trichothecenes in large amounts. They produce an antibiotic that is a trichothecene derivative, which would provide an ideal cover for agent production facilities.

Medical Effects of the Trichothecenes in Humans

The most prominent symptoms associated with trichothecene poisoning are listed in table D-5. Striking among these is the rapid onset of vomiting with severe itching and tingling of the skin. Hemorrhage of the mucous membranes and bloody diarrhea follow. That table also presents symptoms reported to have been caused by the trichothecenes in gas attack victims in Laos, Kampuchea, and Afghanistan. The correlation is striking.

The LD_{50}'s (dose required to produce death in 50 percent of a test population) of the trichothecenes in laboratory animals range from 0.1 mg/kg to greater than 1,000 mg/kg depending on the particular toxin, species, and route of exposure. The LD_{50} of T-2 toxin in cat is 0.5 mg/kg. However, the ED_{50} (dose required to produce a desired physiological effect in 50 percent of a test population) is much lower. The ED_{50} to produce a vomiting reaction is 0.1 mg/kg, and for skin irritation it is in the tenths of microgram range.

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Most of the data concerning the toxicological effects of the trichothecenes are derived from animal data in which pure compounds were administered by oral, subcutaneous, intraperitoneal or intravenous routes. Unfortunately, there are no reports concerning the effects of inhalation of mixtures of the compounds. Therefore, it is difficult to speculate concerning the effects that would be expected in humans who were exposed to an aerosol of mixtures of these very potent toxins. The most useful data concerning exposure in humans was obtained in a Phase I clinical evaluation of anguidine (diacetoxyscirpenol) as an anticancer drug. Diacetoxyscirpenol was administered by intravenous infusion. Doses of 3 mg/m^2/day caused immediate onset of nausea, vomiting, diarrhea, somnolence (and/or mental confusion), fever, chills, a generalized erythema with a burning sensation, hypotension, dyspnea, stomatitis, hives, and ataxia. Because of the side effects the treatment was discontinued. The properties which make the use of diacetoxyscirpenol potentially useful as an anticancer drug are the same as those responsible (in part) for its extreme toxicity. It and the other trichothecenes cause extensive damage to rapidly dividing cells such as tumor cells. Unfortunately, the cells of the lining of the gastrointestinal tract and bone marrow are also rapidly dividing and the effects of the trichothecenes on these cells result in severe rapid degeneration of these tissues. The compounds also have direct effects on the clotting factors in the blood (that is, a primary effect on Factor VII activity and a secondary effect on prothrombin) which result in excessive hemorrhage following trauma.

The other useful body of clinical data concerning the effects of trichothecenes in humans is drawn from descriptions of the course of the disease in the natural outbreaks that occurred in the Soviet Union. The clinical picture may be divided into four stages. The effects produced are very similar to radiation poisoning and there is a latent phase in which the overt symptoms disappear similar to that seen in radiation poisoning.

The first stage occurs within minutes to hours after ingestion of toxic grains. The symptomatology described was produced by oral exposure to low doses. In exposure by inhalation, the symptoms may be more pronounced or the time course accelerated. The characteristics of the first stage include primary changes, with local symptoms, in the

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buccal cavity and gastrointestinal tract. Shortly after ingestion of toxic grain, the patient experiences a burning sensation in the mouth, tongue, throat, palate, esophagus, and stomach as a result of the toxin's effect on the mucous membranes. The tongue may feel swollen and stiff and the mucosa of the oral cavity may be hyperemic. Inflammation of the gastric and intestinal mucosa occurs, along with vomiting, diarrhea, and abdominal pain. In most cases excessive salivation, headache, dizziness, weakness, fatigue, and tachycardia accompany the initial stage. There may be fever and sweating, but the body temperature normally does not rise. The leukocyte count may begin to decrease in this stage and there may be an increased erythrocyte sedimentation rate. This first stage may last from three to nine days.

The second stage is often called the latent stage or incubation period because the patient feels well and is capable of normal activity. It is also called the leukopenic stage because its main features are disturbances in the bone marrow and the hematopoietic system, characterized by a progressive leukopenia, a granulopenia, and a relative lymphocytosis. In addition, anemia and a decrease in erythrocytes, in the platelet count, and hemoglobin occurs. Disturbances in the CNS and autonomic nervous systems may occur. Weakness, vertigo, fatigue, headache, palpitations, and mild asthmatic conditions may occur. Visable hemorrhagic spots (petechiae) begin to appear on the skin and this marks the transition to the third phase. The second stage may last three to four weeks. The transition to the third stage is sudden and symptoms progress rapidly.

In the third stage petechial hemorrhages occur on the skin of the trunk, arms, thighs, and face and head. They can vary from a millimeter to a few centimeters in size. Capillaries are very fragile and any slight trauma results in hemorrhage. Hemorrhages of the mucous membranes of the mouth, tongue, soft palate, and tonsils occur. Nasal, gastric, and intestinal hemorrhages can be very severe. Areas of necrosis begin to appear on the lips, fingers, nose, jaws, eyes, and in the mouth. Lymph nodes are frequently enlarged and the adjoining connective tissue can become so edematous that the patient has difficulty opening his mouth. Blood abnormalities previously described are intensified. Death may occur from hemorrhage, strangulation (due to swelling) or secondary infection.

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The fourth stage is convalescence. Three to four weeks of treatment are required for disappearance of necrotic lesions and hemorrhagic effects. Two months or more may elapse before the blood forming capability of the bone marrow returns to normal.

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ANNEX E

MEDICAL EVIDENCE

Southeast Asia

Since 1976, multiple kinds of sources--refugees, relief medical and civilian workers, and many specially qualified physicians--consistently have detailed unusual signs and symptoms of victims of ''yellow rain.'' Specifically, victims in Southeast Asia subjected to a direct attack of the yellow powder, mist, smoke, or dust would be seen to begin retching and vomiting in a matter of minutes. This and the effects described below were not pronounced in individuals even 100 meters from the attack zone, indicating a relatively dense chemical/carrier combination that was effective in low wind conditions.

Unlike that caused by a traditional riot-control nausea agent, the initial induced vomiting following exposure to ''yellow rain'' was protracted over hours to days often accompanied by dizziness with rapid heartbeat and apparently low blood pressure, chest pain, loss of far-field vision, and a feeling of intense heat and burning on the skin, but not described as being most acute in the groin and axillae. Thus, the acute signs and symptoms match some of the effects of traditional vomiting and blister agents, but clearly not all.

A significant number of victims also reported intense ''red eyes,'' ''bleeding gums,'' convulsions or more often trembling, and vomiting of blood with or without production of copious amounts of saliva within the first hours after the attack again lasting many hours to days apparently depending on the exposure level. Thick mucus, pinpoint pupils, respiratory collapse, prolonged spasticity, and involuntary urination or defecation were never reported after a yellow rain attack, and this absence helped to rule out organophosphate nerve agents in the minds of CW experts. Many medical and environmental samples also ruled out these and other traditional agents such as DM, DS, and others.

Many observers of the ''yellow rain'' effects reported formation within several hours of small (1 centimeter) homogeneous, hard, fluid-filled blisters over only exposed areas of skin, frequently including the victim's hands, arms,

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entire throat, and face, whenever skin was uncovered. In most cases, the vomit, after two to eight hours, contained blood, and in many cases a good deal of it. About half of those receiving the most concentrated doses of yellow material who had been directly under the spray were in several hours after the attack observed to cease vomiting temporarily. This interval was often followed in five to 15 minutes by a period of great pain when the victim would hold his abdomen and emit a ''gush'' of blood from his mouth and nose. These individuals were usually dead within minutes after that. Close questioning by physicians of those who witnessed these final moments leave no doubt that these observed effects were the results of severe gastrointestinal bleeding, significant pulmonary bleeding, temporary compression of accumulated blood in the stomach, and finally projectile vomiting of as much as several hundred milliliters of blood. These findings were consistent with animal and human autopsies.

Many victims of the yellow material received less than the full brunt of a spray, or entered the attack zone several hours to two days later, or consumed food or water contaminated by the material. These individuals often within the next 24 hours developed signs and symptoms similar to those of the more directly affected (but often without pronounced skin effects if they did not contact the powder residue directly). In addition to attacks of intense vomiting (five or six times a day), they also had diarrhea, with bloody stools passed up to eight times a day. Bleeding under the fingernails and around the skin of the eyes and severe bruising of the skin are also commonly reported. Opiates helped the fluid loss in adults; but, in children or young persons not able to tolerate the treatments of raw opium and water, death occurred in about half the cases after 10 days to two weeks. On the basis of reported signs and symptoms, the cause of delayed death was almost certainly dehydration.

In many cases chemical attacks are reported to produce symptoms other than the ones described here. There has always been, however, a direct association of the symptoms above with reports of ''yellow rain'' attacks--that is, when yellow material is used these symptoms appear; other agents may give rise to other symptoms. Although it is possible to have one or even several of these symptoms associated with

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traditional CW agents, no expert has been able to ''fit'' the sequence, severity, and consistency with any of them. In many cases victims and observers were examined, histories taken, and interviews conducted by several health professionals weeks apart. Remarkable consistency has been observed.

From the beginning of the ''yellow rain'' episodes in 1976, autopsies have occasionally been reported anecdotally. Some have been done by less than expert technique, some by nonphysicians, and some were on animals rather than human victims. However, the consistency of the early reported ''putrefaction'' or ''rotteness'' of the digestive tract within 12 to 48 hours after death led many forensic experts to suspect that one effect of the poison, whatever it was, was to cause necrosis (cell death) of rapidly dividing mucosa (mucous membranes), especially in the stomach and upper small intestine. Other autopsy findings included hyperemia (engorgement with blood) of digestive mucosal linings, and remarkably intense congestion and swelling in the lungs, liver, spleen, and sometimes the kidneys. These and other findings often led experts in toxicology and pathology to suggest mycotoxin or even trichothecene intoxication based on clinical and pathological data alone.

Although not a common cause of death, trichothecene effects have been reported in the forensic, oncological, and toxicological literature for several years. Unpublished findings often were discussed in symposiums. In several dozens of cases toxic effects in humans and animals have been carefully recorded, and they match those of the ''yellow rain'' story with good precision. (See table.) There are no additional signs or effects of known trichothecene intoxication not frequently reported by victims, nor are there any reported ''yellow rain'' symptoms that cannot be explained by the effect of the four specific trichothecene toxins found in the samples, and the doses inferred from the operational situation and description.

From a medical viewpoint, there are no significant differences in the reporting from Laos and Kampuchea. The timing and delivery systems have sometimes varied, but the effects of the chemical agent, both clinically and pathologically, are identical. In one case, a series of blood samples from Kampuchean victims also showed a trend toward leukopenia (reduction in number of white blood cells) and the presence of a trichothecene metabolite (HT-2) consistent

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Comparison of Reported ''Yellow Rain'' Effects With Known Trichothecene Effects

Yellow Rain Reports	Effects of Trichothecenes (*)
1. Nausea, vomiting--severe, immediate	1. Nausea, vomiting--severe, immediate
2. ''Falling down, world turning''	2. Dizziness
3. ''Burning of skin'' . . . small blisters	3. Generalized erythema with a burning sensation of skin
4. ''Shaking all over, flopping like fish out of water''	4. Ataxia (failure of muscular coordination), occasional tremors and convulsions
5. ''Bleeding eyes''	5. Congestion of the sclera (white outer coat of eyeball) and blood in tears
6. ''Pounding'' chest, rapid heartbeat, weakness	6. Hypotension (abnormally low blood pressure) with secondary rise in heart rate
7. Severe pain in center of chest	7. Angina (substernal chest pain)
8. Sleepiness, ''not able to talk''	8. Somnolence, central nervous system symptoms
9. Bleeding gums	9. Stomatitis (inflammation of oral mucous membranes) and ptyalism (excessive salivation)
10. ''Can't breathe''	10. Shortness of breath
11. ''Skin and body hot with cold''	11. Fever and chills
12. Diarrhea with blood	12. Diarrhea with blood
13. Loss of appetite, inability to eat	13. Anorexia
14. Bleeding into skin and fingernails	14. Thrombocytopenia (decrease in number of platelets, white blood cells involved in clotting of blood) and purpura (skin discoloration caused by hemorrhage into tissues)
15. Drop in white blood cell count	15. Leukopenia and anemia
16. ''Rotten esophagus, stomach, intestines; soft spleen and liver''	16. Rapid necrosis of linings of gastro-intestinal tract; lymphoid necrosis in spleen and liver
17. Swelling of all organs	17. Congestion of all organs

* Effects are immediate at levels near to or above 500 to 1,000 mg total body burden for an adult. Athough inhalation data are pending, the levels are consistent with reported lethal and sublethal doses. Trichothecenes in combination when directly ingested or inhaled are more toxic in some cases, and the order of signs and symptoms and timing varies.

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with trichothecene intoxication (see annex D for blood analysis results). To a first order, dose-response effects are also seen, and routes of administration are consistent with effects.

Public Health Issues. An early hypothesis (1978-79) was that a significant number of the deaths, especially in Laos, could be explained by the heavy use of riot-control agents such as CS, CN, DM, and agents which cause itching and/or blistering. The hypothesis was rejected quickly on two grounds. First, trace contaminant analysis did not show the presence of any of these compounds in samples (several samples did, however, contain a trichothecene precursor). Secondly, contrary to commonly held views, the epidemiology of diseases endemic to the Central Highlands and the public health of the H'Mong do not support the view of malnourished, disease-ridden, and weak persons who would succomb easily to riot-control agents. Also, a number of studies have shown the opposite: a relatively low incidence of pulmonary disease (lower than what could otherwise account for certain effects); better nutritional states than could otherwise account for death in 10 days to two weeks from water loss (dehydration) and calorie depletion; and a death rate of near zero from causes other than infection, geronto-logical causes, and trauma.

Afghanistan

Some deaths with bleeding have been described in the accounts from Afghanistan. In one series of cases a physician examined a number of persons who had been exposed to sublethal doses of a yellow smoke/black smoke combination attack and one man near death after a series of attacks. Hemoptysis (nasal bleeding)--but not hematemesis (bleeding from the gastro-intestinal tract)--was reported in about half of these and other cases.

Several features of at least one of the chemical agents--an incapacitant--used in Afghanistan defy explanation at this time. One posture is that it is highly selective for the central nervous system rather than the autonomic nervous system. No good candidate has yet been identified which will selectively inhibit the central nervous system to cause unconciousness for several hours as reported. A second finding has been the presence of a dermal anaesthesia, affecting only exposed areas of skin.

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Postattack Medical Survey. There is evidence that after some of the attacks in Laos and Afghanistan, Soviet or Communist (Pathet Lao) forces entered the attack zones to conduct surveys. Several reports indicate that a group of survivors from a toxin attack on a Laotian village were taken several kilometers from the village and injected with a small volume of a clear solution said by their captors to be a ''new'' medicine to ''assess the gas.'' The injections were given intramuscularly in the upper arm and reportedly did nothing to alleviate the weakness, nausea, vomiting, or diarrhea suffered by the survivors. One source reported the effect of the drug was to cause an immediate sensation of warmth throughout his body. Only the use of opium later eased the discomfort, after the survivors had lied to their captors about how much better the new medicine made them feel. It is probable that the procedure was a test, either of a new antidote or of a drug developed to reduce incapacitation from the nausea and vomiting.

Similarly, in a few cases in Afghanistan, Soviet troops were reported to disembark from helicopters or armored personnel carriers at the edge of an attack site. Three or four, dressed in full anticontamination gear, walked among the dead; examined the corpses; and, opening them with a crude autopsy incision, examined the organs in the abdominal and thoracic cavities. In one report a solution was poured into the incision. When the corpses were later recovered by Mujahedin guerrillas, the body cavity contents were destroyed beyond recognition. These bizarre stories would be discounted were it not for the past reliablility and quality of reporting from the sources, which is believed excellent.

These and a small number of additional reports support the hypothesis that the perpetrators of some of the attacks are interested in studying aftereffects, lethality, or some other quasi-experimental aspect of use of a new chemical weapon. Details are not sufficiently clear to explain the purpose of the above events, and ''destruction of evidence'' is by itself not an entirely credible explanation. Recent indications from Afghanistan indicate that one purpose of these reviews of bodies and the field surveys is to determine levels of toxic materials still present in the attack zone before Soviet troops occupy it.

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